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Editorial

Dear IEJEE Readers,

Education and teaching-learning issues are among the topics on the agenda in many countries. Educational issues are complex issues. Educational decisions need research-based knowledge.

Different socio-cultural contexts need different approaches. However, the need for research-based knowledge is not different. Every single actor in the educational sector needs to be equipped by solid competence about her/his area of professional practice.

International Electronic Journal of Elementary Education (IEJEE) is acting as a peer-reviewed scientific channel for dissemination of research based-knowledge and ideas. IEJEE is a member of a global OPEN JOURNAL SYSTEM. IEJEE provides free of charge OPEN ACCESS to their readers. Elementary education is IEJEE's central point of focus. Like the previous volumes and issues of the journal, this issue addresses several important topics and presents interesting findings and perspectives.

I want to thank all the contributors and all the peer-reviewers. I also express my gratitude to Dr. Gökhan Özsoy, Dr. Hayriye Gül Kuruyer and Dr. Turan Temur for their coordinating the peer-reviewing process and for their work as executive editors. Abdullah Kaldırım deserves also thanks for his support and monitoring at the technical side of IEJEE.

Editor-In-Chief

Prof. Dr. Kamil Özerk,
IEJEE

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All responsibility for statements made or opinions expressed in articles lies with the author.

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A Teacher's Dilemma in Creating a Democratic and Socially Just Classroom

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Abstract

This qualitative case study aims to understand teaching experiences of a recent graduate of a social justice-oriented program in the U.S. It examines what dilemma(s) the teacher reports and how she copes with them. In-depth interviews and document collections are used as the means of data construction. Thematic and dialogic/performance analysis methods are utilized for data analysis. The analysis of the teacher's case demonstrates that the competing discourses circulating in the school produce significantly different ideas of what a "good" teacher is and does; the differences constituted through the discourses create contradictions affecting the teacher's lived experiences. The teacher reports her struggle to become a critical and, yet, unbiased teacher. It also shows that the teacher deals with the dilemma by re-interpreting the discourses that she finds limiting. This study confirms and, yet, extends the exiting body of research as it sheds lights on how the teachers' experiences are shaped by and, simultaneously, re-frame the discourses surrounding her. Future directions for research and practice are discussed.

Keywords: Teaching for Social Justice, Democratic Education, Teacher Education, Case Study

Introduction

Schools have been failing to address educational equity. Researchers have reported the disparities in funding, monetary and technological resources, numbers of certified teachers, instruction quality, and educational outcomes between students with and without the advantages conferred by race, gender, class, language, and dis/ability (Anyon, 1997; Apple, 2006; Darling-Hammond, 1997; Darling-Hammond, 2004; Ferguson, 2000; Giroux, 1997; Rothstein, 2004; Valle & Connor, 2011; Zollers, Albert, & Cochran-Smith, 2000). Within this context, increasing numbers of scholars consider teacher education to be a crucial element in building a more "just" society (Athanases & Martin, 2006; Cochran-Smith & Fries, 2005; Cochran-Smith, Shakman, Jong, Terrell, Barnatt, & McQuillan, 2009; Hollins & Guzman, 2005; McDonald & Zeichner, 2009).

Conceptualizing teaching and teacher education in terms of social justice has been an important agenda for educational researchers and teacher educators. The social justice agenda aims to prepare teachers to be professional educators and activists who are committed to dismantling social and educational inequities (Cochran-Smith, 2005; Zeichner, 2003). It conceives teacher education as a crucial factor in development of more equitable and just school and society. Teacher education for social justice, however, is interpreted through a range of different practices and values with multiple philosophical and theoretical groundings. Teacher education programs highlight various perspectives including, but not limited to, multiculturalism, culturally relevant pedagogy, anti-oppressive education, and inclusive education to implement their commitments to social justice.
Sleeter (2009) explains teacher education intended to promote social justice as being constituted by the following three strands:

> *(1) [S]upporting access for all students to high-quality, intellectually rich teaching that builds on their cultural and linguistic backgrounds; (2) preparing teachers to foster democratic engagement among young people; and (3) preparing teachers to advocate for children and youth by situating inequities within a systemic sociopolitical analysis. (p. 611)*

A number of teacher preparation programs in the U.S. have made structural and curricular changes with commitments to social justice (Cochran-Smith, 2005). Most teacher education programs have added courses that incorporate some combination of the above and/or other relevant perspectives (Darling-Hammond, 2006; Zeichner, 2006); some programs have required clinical experiences with diverse students (Ladson-Billings, 2001). In social justice-oriented preservice programs, first, teachers are prepared to possess a body of content and pedagogical knowledge; however, they also learn to critique the very idea of knowledge by considering whose knowledge is valued for whom and for what purpose (Cochran-Smith, 2008). Second, teachers are encouraged to actively interrogate their own interpretive framework(s) through which they understand their students, make decisions, and form relationships because it is closely linked with students' learning and life opportunities (Cochran-Smith, 2008). Third, teachers are prepared to understand and utilize guiding pedagogical principles that can foster justice such as developing caring relationships with students (Noddings, 1984), designing culturally relevant instruction (Gay, 2000; Ladson-Billings, 1995), and enabling students to acquire access to the dominant culture of power and to critique the dominant culture itself (Nieto, 2003). Lastly, teachers are expected to become activists as well as educators using a political consciousness (Cochran-Smith, 2008).

While much attention has been paid to how preservice teachers are prepared in social justice-oriented teacher education programs, there is a scarcity of studies investigating how their learning is translated into practice (Dover, Henning, & Agarwal-Rangnath, 2016; Grant & Agosto, 2008; Um, 2019). The exiting literature reports that teachers generally acknowledge and struggle with the disconnection between ideals of social justice and their day-to-day teaching contexts.

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Some studies present that teachers encounter dilemmas associated with their limited capacity to enact a vision of social justice in their school contexts (Agarwal, Epstein, Oppenheim, Oyler, & Sonu, 2010; Chubbuck & Zembylas, 2008; Paugh, 2006; Nixon, 2010). This study seeks to contribute to the body of knowledge by investigating a case of a teacher who experiences dilemmas in a space where competing discourses meet and clash.

In this study, I examine teaching experiences of a recent graduate of a social justice-oriented program in the U.S. I seek to pay more attention to the ways in which the teacher's experiences are discursively constituted by the competing discourses that surround her. The guiding questions are as follows: a) What dilemma(s) does the teacher report as a graduate from a social justice-oriented program? b) How does the teacher cope with the dilemma(s)?

Method

This qualitative case study involved a female elementary school teacher, Lauren (pseudonym), who is a white Jewish woman in her mid-twenties. At the time of the research, she was teaching in a 4th grade team teaching classroom at Central Elementary School (pseudonym) located in an area that is a technically city but more like a large suburb. The Central Elementary School enrolled approximately 400 students (67% White, 11% Hispanic, 10% Asian, and 6% African American). Almost 10% of the students were English Language Learners. As the school district had a state funded desegregation program, some of the African American and Latino students in her class were bused to attend the school. The Central Elementary School comprised kindergarten through 5th grade, and there were three or four classes per grade level. The school had two team teaching classrooms, one in 4th grade and the other in 5th grade.

Lauren graduated from a social justice-oriented elementary preservice program at a large university in Northeastern State in the U.S. The preservice program led to an M.A. degree and teacher certification(s). It was a dual-certification program, meaning that students could pursue either single-certification in elementary education or dual-certification in both elementary and teaching students with disabilities in grades 1-6. The teacher education program highlighted its commitments to social justice. Through various courses, assignments, and student teaching experiences, the program sought to prepare their preservice teachers to acquire knowledge about the various forms of oppression operating in schools and society, while also developing their pedagogical skills to promote educational and social equity. The selection of the preservice program was a matter of access.

I used in-depth interviews as the primary means of data construction. I embarked upon a series of seven interviews with Lauren from January 2013 to June 2013. The interviews were approximately 60-90 minutes in length and arranged at her convenience on a regular basis once every two to three weeks. All interviews were audiotaped and transcribed. In addition, I collected documents that Lauren generated for instruction during the 2012-2013 academic year as additional data for this study. The documents included teacher-produced curricula, lesson plans, lesson materials, classroom charts, and class blogs. The data were analyzed in two ways. First of all, I conducted thematic analysis that focused on what the participant reported regarding the issues central to this study (Riessman, 2008). In addition, dialogic/performance analysis was used to examine how broader contexts informed the ways in which the participant constructed and interpreted her teaching experiences (Riessman, 2008). For dialogic/performance analysis, I identified specific discourses that circulated in statements made by the participant and examined how her accounts about her teaching experiences drew on and reinforced the discourses.

Results: Lauren's Story

Journey to Becoming a Teacher

Growing up, Lauren always knew she would be a teacher. In many videos her mother recorded for Lauren when she was young, she was lining up her dolls and teaching them. She remembered how much she enjoyed interacting and connecting with younger people. As a student, she always loved school. Not only did she feel comfortable, but she also excelled in school. Yet, her decision to be a teacher might not be explained without her commitment to promoting social equity.

> *Once I really started to think more about equity, I started to really see that this [teaching] was my calling because there's a lot of ways to try to make the world a more equitable, fair, just, and right place, which is really what I wanted to do. But, this was a choice I made that I think linked up with my interests.*

She grew up in a family dedicated to addressing various issues of in/equity. Her grandparents were active advocates in the Civil Rights Movement; her grandmother was at Martin Luther King's "I Have a Dream" speech as a supporter. Her maternal grandparents worked on fair housing committees in New Jersey, fighting for equal housing for people who were racial profiled. Lauren said, "So, you could say it's in my blood to think about these kinds of things."

While attending public schools from kindergarten to college, Lauren felt how inequity exists along the lines of gender, race, ethnicity, class, religion, language, nationality, and disability in school. She remembered how she felt uncomfortable when she noticed her peers' self-segregation along "racial lines" in her middle school cafeteria and how she felt strange when she transferred to the wealthy, "white" high school. Although she was engaged with and wrestled with the issues of difference and in/equity in her middle and high schools, she did not frame the issue in a way that she does now until she entered the college. It was one of her college courses that offered her the framework to make sense of her experiences. Majoring in psychology and minoring in education, she took a course with a faculty member who was involved in the Freire Project launched by the Faculty of Education in the college. Through the course, she read articles like Peggy McIntosh's *White Privilege: Unpacking the Invisible Knapsack*. She appreciated the opportunities that pushed her to question what she had taken for granted.

After graduating from the college, Lauren applied for the elementary preservice program, being certain that she wanted to be a teacher. She was intrigued by the ways in which the program described its commitments to social justice. The preservice program offered her an "innovative and cutting-edge environment to learn." What she learned in the program was eye-opening to her. Lauren had many "aha" moments that stimulated her practically and intellectually. Going through the program, Lauren could analyze how school systematically privileges some students and marginalizes others more critically. Lauren could form relationships with people that she could consider her "colleagues for years down the road." She met many people who could share similar commitments and provide emotional supports and informational resources. Lauren graduated from the preservice program in February 2012 with both elementary and special education teacher certificates.

Lauren started her teaching career in a kindergarten self-contained classroom at a public elementary school. Lauren chose to work in the setting that she regarded as exclusionary because she thought it would be an "interesting and powerful way to push up against that system, to kind of fight it from within." She strived to pull students out of her self-contained classroom and place them into a space where they could learn with their non-disabled peers. However, it did not take too long for Lauren to realize that the existence of her self-contained classroom itself impeded her efforts to promote inclusivity in the school. Her students remained as "guests" in the general education classrooms in which they were placed. She could not get rid of the feeling that she was reinforcing the status quo by the very nature of her position. She felt torn working in the environment. After spending a semester at the school, she decided to quit the job. In September 2012, Lauren moved to Central Elementary School hoping for a working environment more aligned with her educational philosophy.

Ideals of Democratic Education

Lauren taught in a 4th grade team teaching classroom at Central Elementary School at the time of the research. Her co-teacher was Stacey who graduated from the same teacher education program. Lauren strived to cultivate a classroom community that was genuinely democratic. Lauren believed that her ideals of democratic education was the manifestation of the commitment of her preservice program to social justice. She hoped that every student could be positioned as a valued member regardless of their differences. Lauren thought some students are often positioned as less able, not interested in learning, and problematic by various taken-for-granted school routines and structures. To cultivate a democratic community, Lauren recognized the importance of disrupting such "old habits" as ability-based grouping, conventional homework assignments, and top-down disciplinary strategies.

Lauren often used such phrases as "giving voice" and "being heard" to describe her ideals of democratic education. For Lauren, democratic community should be built on every member's right to speak and to be heard. One of her goals as a teacher was to help her students develop their voice for "stand[ing] up for each other, raising concerns, talking about an issue, pushing back against something the teacher says even, or initiating a class vote around something." Lauren hoped to undo the top-down schooling practices that might silence students and to enable them to be "authors" of their own world. Moreover, she taught her students to listen deeply to others. In her class, there were on-going conversations around what it would mean to be heard and what it would look like. She often reminded her students that "they have a voice that is valuable, they have a story to be told, that others want to hear it, and others will wait for that story to be told and be patient around it."

Moreover, Lauren associated democratic education with a universally designed teaching approach that could grant all students access to learning experiences regardless of their cultural, racial, and linguistic backgrounds, preferred modes of learning, and disability. The version of democratic education that she envisioned would not privilege some students over others based on their conformity to the "normal" ways of learning. Thus, Lauren sought to understand each student's strengths, wants, and needs through different types of surveys and to make pedagogical decisions based on such information. Allowing diverse ways of engaging with materials and exhibiting their understanding were examples of her practices that aimed to promote democratic education. In her 4th grade classroom at the Central Elementary School, Lauren hoped to make sure that her students could feel a sense of community, recognize their right to speak and to be heard, and participate in accessible learning activities.

Becoming a Critical and Unbiased Teacher

Lauren did not view school as an educational institution that could promote meritocracy, interest-neutrality, and equal opportunity. For her, school was a place where certain groups of people were privileged over others. She was committed to altering her own and others' discriminatory beliefs and practices that might replicate unequal power relations. Lauren attributed this commitment partly to her preservice program, which encouraged her to see herself as a change agent working to transform the unjust educational and social system. Lauren had an impression that the program expected its graduates to "have conversations around issues like race, ethnicity, privilege, socioeconomic status, gender, sexuality with their students" and to develop a critical consciousness about their surroundings.

Although she recognized the importance of promoting students' critical thinking, Lauren found herself feeling uneasy about openly discussing social issues with her students. Lauren did not want her students "questioning everything with regard to race or disability just because I [she] said so." Lauren stated:

> *By avoiding a social justice framework in the way I've conceived of it here as a way of questioning of these relations, cross relations, power dynamics, I think I move away from imposing [my] political views upon students and instead move more toward having students enter into a dialogue with me, some kind of a conversation that goes back and forth, in which they experience a freedom to agree or disagree. Today a student openly disagreed with me, a student who rarely speaks up. An English language learner who has a communication disability, labeled as such, and I find, I found that experience to be exactly how I perceive a democratic education. I made a comment about how, if there were bullying situations that, if other people stood up in a group against a bully, it would be a way to make the bully stop bullying behavior, and this student said, "I disagree because I don't think that would stop a bully. I think they're stronger than that." And, I told him how much I appreciated him for disagreeing with me. In May of my first full year teaching, I feel like that's a huge accomplishment that I've cultivated a community and relationships with students where they feel like they can disagree with me.*

Although she understood the importance of developing students' critical thinking skills, Lauren was afraid she would impose her political views when she, as a class authority, revealed her opinions on social issues. Lauren was nervous about the possibility of silencing her students who might have different ideas than hers. Lauren did not want her students to adopt her viewpoint passively. While I noticed her stance on this specific issue was constantly shifting throughout the research, Lauren, in that particular moment, thought that the social justice framework conflicted with her ideal of democratic education because it might threaten the freedom of speech that she strived to cultivate.

After the interview, the comment Lauren made about teaching for social justice haunted her. Lauren had to revisit her paradoxical feelings about it. After a conversation with Stacey about the issue, Lauren said:

> *My co-teacher and I had a different... had an interesting conversation about this a couple weeks ago, and she said, "But teaching for social justice is the right way to think," and I said, "Yeah, to us. And I agree it's the right way but it's not to everyone." And so, particularly people of I think certain political agendas are going to think differently about that. And there*

> *may be parents in our classroom who are raising their kids to have certain prejudices against certain types of people, and that's where I start to feel uncomfortable because of course I don't want my students developing those kind of prejudices, but I also feel kind of uncomfortable intervening in parenting styles and trying to override that in a childhood education. And I guess some critical questions for me about what the role of an educator is in raising a child's thinking.*

While Stacey, in their conversation, seemed to firmly believe that teaching for social justice would be the "right" way no matter what, Lauren was unsure. Lauren did not want to perpetuate the social relations and hierarchical dynamics situated in society. She did not want to leave the dominant viewpoint unchallenged in her classroom. Nevertheless, Lauren could not avoid feeling that she might impose her own political viewpoint through the framework of teaching for social justice. She was also uncertain about what she should do when parents might not want their children persuaded by her political view. The uncertainty over what role she should play as a teacher made Lauren hesitate when pursuing what she thought was social justice education.

Approximately four weeks after she expressed her discomfort with teaching for social justice, which, she assumed, required discussions around social issues, Lauren mentioned that Stacey and she started to do "some of the first real like social justice work because there have [had] been some shifts in my [her] thinking." Lauren elaborated how her view had been changed.

> *When I took this job almost a year ago now, I was so overwhelmed and just in survival mode that I couldn't get to some of this more critical and creative thinking. And, kind of once I hit my one-year mark in teaching, like, maybe for me around February-March, I don't know, maybe more like April, I felt a real turning point not just in, like, social justice but in other kinds of lesson planning and teaching as well to become more of the teacher I want to be. So I think some of it is just developmental of a learning curve. I think right now my thinking… It has shifted a lot but right now my thinking is that there is merit to including and incorporating social justice as a thread and an idea throughout teaching and kids' education. I don't see it is as needing to be as central though as I think the preservice program made it out to be infused as profusely as I think it was made out to be at the preservice program. [What] I think more importantly is: how do you get kids to have deep conversations about anything? How do we get them to interact thoughtfully and productively with each other? How do you cultivate a community of thinkers and listeners where people are respected, where kids feel comfortable voicing their opinions?*

Lauren assumed that the change occurred because she could get out of the "survival mode." She felt that she had more time and energy, which she did not have before as a newly appointed teacher, to incorporate issues of social in/justice into her lessons. As she could move to the next learning stage, Lauren started to see the benefit of teaching about issues of social in/justice. However, Lauren did not believe that it should be the central theme of her teaching as her preservice program encouraged. Instead, Lauren aimed to create a space where her students could think about various issues deeply, stand up for their own beliefs, and respect different opinions. Lauren explained how the shift in her thinking had informed her pedagogical approach.

> *Students read books that had similar themes around discrimination, racism, um, immigration. And, we had what we called an Upstanders Conference. […] We really struggled because that seemed like pushing a political agenda. That kind of thinking around how you're not going to be racist or how you're not going to discriminate, and that also felt a little bit preachy. And, we didn't think it would be so rich because we thought the kids would just kind of be saying what they thought we wanted to hear instead of just really having a full out conversation of some of these critical issues. So we really struggled with how we were going to bring together all these themes that they'd been talking about. Eventually, we settled on a series of statements that tied into our class read-aloud and had strands or threads of social justice woven into them, but they weren't explicit. They were disguised in the context of the book.*

The Upstanders Conference was planned to help students critically understand the world around them. However, Lauren noticed that the conference became "preachy." She did not want to cultivate a black and white morality in her students' minds; she did not want her students to construct the simple binary of justice versus injustice. Instead, she sought to encourage them to form their own stance on an issue and communicate their opinion with others respectfully. To make it happen, she had to make what was good/bad or just/unjust less dichotomous. For example, they read a book: *The Watsons Go to Birmingham – 1963*. The book was about a family traveling to Birmingham in 1963 when there were racial riots and bombings. After reading the book, Lauren presented the following statements to her students: a) The character in the book who has the most courage is Kenny, b) Mrs. Davidson should have given Joey a black doll rather than a white one, c) Kenny shouldn't have shared his lunch with Rufus, d) When he beat up Larry Dunn, Bryon gave him what he deserved for stealing, and e) Byron shouldn't have been punished for his choice of hairstyle.

Then, the students decided whether they agreed or disagreed with each statement and made an argument for their point of view. They were allowed to switch sides. Through this strategy, Lauren attempted to avoid imposing her opinions on the students and pushing her political agenda. Lauren was satisfied with how her students were engaged in the topics. They had a "meaty discussion" over the issues of social in/justice "within a context that they were able to access." Lauren thought this approach was able to elicit a multiplicity of views. Many of the students questioned their peers who had different opinions, and they reconsidered their own understanding through the discussion. Lauren said, "This is really where I see democratic education entering into my philosophy.

Discussion

Lauren exhibited a feeling of discomfort about incorporating controversial social issues into curriculum, which she conceived as an important part of social justice education. It appeared, to me, that it was an effect of the competing discourses available to her. The discourse of progressive education, the discourse of critical pedagogy, and the current conservative discourse of critical thinking played an important, not complete, role in making controversial social issues uncomfortable. Although I acknowledge these discourses cannot be pinned down for definitive purposes because they are constantly re-inscribed with new meanings, I unavoidably essentialize them in order to explain what I mean by them and how they might inform Lauren.
The discourse of progressive education, first of all, has been circulating within educational fields in the U.S. since early twentieth century. John Dewey's ideas on democratic life and education in works like *The School and Society (1899), The Child and the Curriculum (1902), and Democracy and Education (1916)*, offered a significant basis for the discourse of progressive education. Ironically, there have been criticisms of how Dewey is misrepresented through the discourse of progressive education (Cahn, 1988; Fallace, 2011; Stanley & Nelson, 1994; Weiss, DeFalco, & Weiss, 2005). For example, according to Cahn (1988), Dewey explicitly expressed his opposition to progressive education for its rejection of teacher's pedagogical authority and romanticism of student caprice. Weiss and

her colleagues (2005) argue that Dewey's ideas have been misinterpreted as making students' life experience as end unto itself rather than as a means for their meaningful interaction with subject matters. The discourse of progressive education has offered many teachers who identified themselves as progressive with a convincing rationale for their antiauthoritarian practices. Progressive educators emphasize the value of respecting individual students' differences to create meaningful and joyful learning experiences. They also seek to actively engage young people in decision-making about numerous areas of classroom operations. As a progressive teacher constituted through this discourse, Lauren had explicit commitments to creating a democratic classroom community in which, each student's diverse ideas, abilities, interests, and needs would be respected.

Another discourse that impacted Lauren was the discourse of critical pedagogy. Influenced by thoughts of Paulo Freire, there have been educators who conceptualize teaching as a means of social reform (e.g., Henry Giroux, Michael Apple, Peter McLaren). They assume that schools reflect and replicate power-laden, often hierarchical, structures of the society and that schools should be institutions that prepare citizens to create a more equitable and just society. Within this discourse of critical pedagogy, the teacher should play a role in making curricular changes to enable students to critically think through various social and political issues. The type of criticality promoted by this discourse involves raising questions that are naturalized and, thus, not generally asked. In other words, the criticality associated with the discourse of critical pedagogy endorses questions like "what made the situation as it is, who made the situation as it is, and whose interests are served by the status quo" (Applebaum, 2009, p. 397).

Lauren acknowledged that this discourse of critical pedagogy circulated in her teacher education program and imposed a certain expectation on her; that is, she, as a teacher, should enable her students to pay attention to various forms of injustice deeply entrenched in the taken-for-granted structures of the society using curricular changes. Recognizing historically embedded inequities in schools and in the society, Lauren desired to contribute to redressing them as a teacher. Yet, she did not feel comfortable incorporating controversial social issues into the curriculum. Lauren was aware of the unequal weight and legitimacy between her and her students' voices. Thus, she worried that she might replicate the authoritarian school culture by starting discussions on controversial issues and revealing her opinion. Lauren felt the tension between the discourses of progressive education and critical pedagogy. Lauren was uncertain about using her institutionally given power to disrupt power relations. Lauren's concern partially reflects critical pedagogues' on-going conversations about the ethical dilemmas created by "the disparity between the ideals of participatory democracy and the realities of social inequality" (Boler, 2004, p. viii).

More recently, conservative activists and politicians have produced a discourse that uses languages of progressive education and critical pedagogy but in a quite different way (Laats, 2014). Pointing to the traditional, top-down, and autocratic features of public schools, they worry that students are subject to indoctrination in the guise of education. Today's social conservatives call for critical thinking skills in school that enable students to analyze given information, form their own opinions, and respectfully respond to other ideas on controversial issues. They argue that students must have freedom to dissent from teachers' intellectual impositions. Laats (2014) lists various cases in which social conservatives have attempted to introduce school laws that develop critical thinking and prohibit intellectual discrimination against those who have different ideas including conservative leanings (e.g, Senate Bill 1765 in Oklahoma, House Bill 207 in Virginia, House Bill 1587 in Missouri).

This discourse of critical thinking posits teacher as a nonpartisan referee, who ensures fair competition between multiple perspectives. When teachers use their authority to take a partisan role in classroom discussions about controversial issues, fair competition among diverse ideas is thwarted. This discourse uses the languages associated with progressive and critical educators but with the implicit purpose of preserving social norms (Laats, 2014). Lauren recognized that this discourse offered many people in her school and in the society with a "convincing" framework of critical thinking. Lauren was not sure what to do when the parents of her students accused her of using the classroom "as a political podium at the expense of intellectual diversity" (Applebaum, 2009, p. 377). This conservative discourse of critical thinking also informed Lauren's teaching experiences.

These discourses construct conflicting meanings of what a teacher is and does. Being located in a space where these discourses merged and clashed, Lauren struggled with negotiating among competing desires and demands, which were not separated but interconnected in complex ways. Lauren sought to become a progressive teacher who could mitigate autocratic school cultures and practices. She also hoped to prepare her students to become critical citizens who could understand and challenge power-laden social structures. However, she was careful in order to avoid taking a partisan role to create a nondiscriminatory classroom environment. Lauren questioned if using her institutionally given power as a teacher to disrupt power relations in the society could be considered as justice. She was concerned about the possibility that she could marginalize some students' "voices" if she made her political opinions explicit in her class.

The competing discourses that were available and somewhat persuasive to Lauren constructed the conflict: becoming a critical and unbiased teacher. She sought to address this conflict through an instructional approach named "the Upstanders Conference" in which students could think about various issues deeply, stand up for their own beliefs, and respect different opinions without necessarily knowing their teachers' opinions. By making social issues less explicit and spotlighting student opinions, rather than hers, in discussions, Lauren could partially fulfill the incompatible desires and demands. Lauren slightly changed how she thought about teaching for social justice in order to be a critical and unbiased teacher. She refracted the discourse of social justice education so that she could promote "the ideals of participatory democracy" and, simultaneously tackle "the realities of social inequality" (Boler, 2004, p. viii).

Conclusion

A number of teacher education programs seek to prepare teachers who are committed to promotion of "social justice" while great variation in the use of the term exists. However, there is a paucity of follow-up studies that explore teaching experiences of graduates from teacher education programs that foreground social justice. This study is one of the few follow-up studies. In this qualitative case study, I have examined teaching experiences of one teacher who graduated from a social justice-oriented preservice program in the U.S. My analysis of the teacher's case demonstrates that the competing discourses circulating in the school produced significantly different ideas of what a "good" teacher is and does; the differences con-

stituted through the discourses created contradictions affecting the teacher's lived experiences. It also shows that the teacher dealt with the dilemma by re-interpreting the discourses that she found limiting. This study confirms and extends the exiting body of research as it sheds lights on how the teachers' experiences were shaped by and, simultaneously, re-framed the discourses surrounding her.

I make some suggestions for future directions. First of all, we, as teacher educators and researchers, need more "teacher stories" that examine the lives of teachers who encounter conflicting demands and desires. We can explore the opportunities that postfoundational theories create to examine the complex ways in which teachers interpret and cope with the conflicts. It would be interesting to research a teacher or a group of teachers over a long period of time across their career span to examine potential long-term consequences associated with teaching practices and the effects of cross-situational changes. Studying a teacher network that aims to reform educational systems can also provide some important insights not found by researching individual teachers. Moreover, teachers can engage in teacher action research to document and analyze their own teaching experiences including how they cope with conflicting demands and desires; or, teachers and teacher educators can collaborate in an inquiry on this issue. This type of research, where teachers participate as researchers, might produce different knowledge than the traditional form of educational research where they are positioned as informants. This type of research can also help us examine how intentions and effects of teachers' practices are (dis)connected in complex ways and, thus, offer further conceptual frameworks for understanding and interpreting the issues.

Furthermore, we need to tap into the possibility of teacher stories in teacher education settings. The biggest contradiction that we encounter in this current political and historical context is to prepare teachers who are capable of promoting inclusivity and social justice in schools where conflicting discourses of education circulate. Teacher educators can use teacher stories to initiate discussions about what it means to teach with a commitment to more democratic and socially just teaching. Teacher educators can support prospective teachers to acknowledge the contradiction of enacting their commitments and, yet, avoid becoming closed to possibilities for change. Prospective teachers can recognize how other teachers are engaged in local forms of resistance and what potentials and limits such practices have. They can understand ambivalence and the complexities of working within and against the system. They can learn from other teachers and acknowledge what possibilities they can cultivate as a teacher. They can extend their imagination to devise small and creative ways of leaving their marks on their day-to-day context rather than feeling defeated.

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The Promotion of Self-regulated Learning by Kindergarten Teachers: Differential Effects of an Indirect Intervention

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Abstract

The early promotion of self-regulated learning (SRL) has aroused increased interest since it has been highlighted as the key competence for lifelong learning (E.U. Council, 2002). To meet the demand for early support, an intervention for kindergarten teachers to foster SRL in five to six-year-old children was developed (Venitz & Perels, 2018). In the present study, different SRL promotion strategy profiles of kindergarten teachers were investigated by using latent profile analyses and the effectiveness of the developed intervention was evaluated under consideration of the found profiles. The results of latent profile analysis (n= 134 kindergarten teachers) displayed specific profiles that differ regarding the degree of self-reported knowledge concerning strategies to promote SRL in children. Using a sample of n= 76 kindergarten teachers who participated on a three-week training which was focused on the reflection of the own SRL as well as the promotion of SRL, differential effects of the found profiles were investigated. The results indicate that an adaption of the intervention according to the different SRL promotion strategy profiles would be meaningful, because kindergarten teachers with high and low SRL promotion strategy profiles differed significantly concerning their repertoire of supportive strategies and their SRL behavior.

Keywords: Differential Effects, Self-Regulated Learning, Kindergarten Teachers, Training, Latent Profile Analysis

Introduction

Against the background of social change processes that contribute to a growing relevance of lifelong learning processes, self-regulated learning (SRL) is increasing in importance (see Fthenakis et al., 2007; Lüftenegger et al., 2012). Therefore, the promotion of independent, self-directed forms of learning is one of the most important aims of the German early education system (KMK, 2004) and should begin as soon as possible (Secretariat of the Standing Conference of Ministers of Education and Cultural Affairs of the Länder in the Federal Republic of Germany, 2015). An early promotion of SRL has an advantage over later support as learning behaviors are still malleable, increasing the positive influence of the SRL processes (Dignath, Büttner, & Langfeldt, 2008; Perels & Otto, 2009). In addition, "relatively small self-regulatory differences in early childhood can be magnified to progressively larger differences over time" (Baron, Evangelou, Malmberg, & Melendez-Torres, 2015, p. 1). Thus, early promotion of SRL can play a preventive role. In this context, kindergarten teachers are encouraged to continuously develop their knowledge and competence concerning the promotion of children (e.g., Lindeboom, & Buiskool, 2013; Secretariat of the Standing Conference of Ministers of Education and Cultural Affairs of the Länder in the Federal Republic of Germany, 2015), so SRL is also a highly relevant competence for early childhood educators. In addition, the demand on teachers to "be familiar with the factors that influence a learner's ability to self-regulate and the strategies they can use to identify and promote self-regulated learning (SRL) in their classrooms" (Zumbrunn, Tadlock, & Roberts, 2011, p. 4) can also be transferred to the kindergarten context. Empirical findings provide hints that relevant skills or methods to foster SRL of kindergarten children can be effectively mediated by professional programs (e.g., Perels, et al., 2009). Hence, an intervention to promote the SRL behavior of kindergarten teachers as well as their knowledge about strategies to foster SRL in children, appears useful. Therefore, in a further study by Venitz & Perels (2018), an indirect intervention for kindergarten teachers which focuses on the SRL promotion of five to six-year-old children, was developed. As research on SRL of educational staff in school contexts indicates that there are individual differences in the support of SRL (Moos & Ringdal, 2014), an investigation of differences with regard to early childhood educators' knowledge about SRL promotion strategies seems to be of special importance. That is why the present study seeks to investigate different profiles with regard to knowledge about SRL promotion strategies within a sample of 134 German kindergarten teachers, following a person-centered approach (Niemivirta, 2002). According to the Aptitude-Treatment-Interaction approach (Snow, Corno, & Jackson, 1996), differential effects of SRL profiles on an indirect SRL promotion strategy training were investigated via repeated measurement analyses.

SRL and its Relevance for Kindergarten Teachers

After the E.U.-Council (2002) report was issued, "self-regulated learning has been highly praised as the key competence to initiate and maintain lifelong learning" (Dignath et al., 2008, p. 102). Because of an increasingly faster alteration of knowledge in a highly technically developed society, an independent acquisition and continuous extension of knowledge is required, which can be facilitated through recourse to SRL strategies. Therefore, SRL, or the ability to initiate (learning) action processes autonomously, to adapt them continuously on the basis of self-observations and to reflect upon them (Zimmerman, 2000), has become one of the most important aims of the German education system and is of growing interest for researchers (e.g., Dignath, Büttner, & Langfeldt, 2008; Wigfield, Klauda, & Cambria, 2011; Perry et al., 2010). As the theoretical foundation of the intervention that was used as the database for the investigation of differential training effects, the social-cognitive process model of Zimmerman (2000) was chosen, which distinguishes three central learning phases (forethought phase, performance

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phase, and self-reflection phase). The model offers an indept explanation of SRL processes and related strategies, so it offers a solid knowledge base for kindergarten teachers and can be used for the (further) development of knowledge concerning strategies to foster SRL in children. In the first phase of the model (forethought phase), the focus is on planning the action, including analysis of the task, clarification of the challenges of the task and motivational processes. The second phase (performance phase) places pivotal importance on competencies like self-control and self-monitoring, meaning the conscious perception and analysis of inner experience and behavior. Here, the learning action is implemented while maintaining a focus on the planned aims. Central elements of the third phase (self-reflection phase) are self-evaluation and self-reaction, meaning that the task that was completed is compared with the aims set forth at the beginning of the task and evaluated in terms of its success (self-evaluation). As a consequence of the self-evaluation, a self-reaction takes place. If learners are displeased with the result of their work, they should adapt either their original aim or the strategies used in future learning actions. Zimmerman (2000) described a model consisting of several processes that are subjected to continuous adaptation and, therefore, an optimization of the learning behavior, so it offers suitable points of reference for an intervention study. However, abilities linked to the monitoring and the evaluation of one's own behavior in children of kindergarten age are doubted by some authors (e.g., Veenman, Van Hout-Wolters, & Afflerbach, 2006). Certainly, results by other researchers like Bronson (2000), Whitebread et al. (2009) or Hoyle & Dent (2018) assume that there already is a notable difference in metacognitive abilities, such as monitoring behaviors, the control of attention, and the adaption of strategies on the basis of self-evaluation, in comparison with infants and toddlers.

Thus, SRL is seen as an ability that can already be promoted in children kindergarten age by an increased number of researchers. These findings suggest that children seem to possess basic abilities to learn self-regulation, which can be further developed by additional support through interactions with competent educational staff and a structured learning environment (see Bruder, 2006). As it describes single learning processes, in which kindergarten teachers can orient themselves in their support of SRL, the social-cognitive process model by Zimmerman (2000) offers a suitable theoretical foundation for an intervention for children of kindergarten age and their reference persons. To date, SRL and its promotion has been mainly investigated in a school context (e.g., Cleary, Platten, & Nelson, 2008; Fuchs et al., 2003; Leidinger & Perels, 2016; Perels, Gürtler, & Schmitz, 2005; Rosário et al., 2007), but not often in a kindergarten context, so there is a lack of research concerning the SRL of kindergarten teachers and its promotion, although it can be expected to have significant implications for their daily work (e.g., Chatzistimatiou et al., 2014). Research in a school context suggests, "that if teachers become self-regulated in their own learning, their experience in self-regulatory processes can help them to develop strategies for teaching self-regulation to their students" (Senler & Sungur-Vural, 2014, p. 552). Because the work of kindergarten teachers is marked by a "rapidly changing environment" (Peeters et al., 2014, p. 1964), an ongoing adaption and extension of their knowledge of how to support children is required (Lindenboom & Buiskool, 2013). Thus, it can be stated that SRL also holds importance for early education staff. In a school context, it is stated that teacher first "need to be self-regulated learners themselves due to ever-changing curricular revisions, which require innovation and adaptability" (Moos & Ringdaal, 2012, p. 3) to continuously regulate their own learning and that they have to support the development of SRL behavior of the children they teach. This assumption should also be transferable to the early education context. Although the theoretical assumptions demonstrate the importance of a teachers' knowledge of SRL promotion strategies, findings from Perry, VandeKamp, Mercer and Nordby (2002) in a school context indicate that teachers recognize the importance of SRL and are willing to help students build beneficial SRL behavior. However, they are "unsure of the tasks and practices that support it" (Serratore, 2015, p. 8). Transferring the findings to a kindergarten context, a reinforcement of kindergarten teachers' knowledge of strategies to promote SRL in children and a reflection on their own SRL seem to be of particular importance. Therefore, the presented training (Venitz & Perels, 2018) pursued two essential key goals: First, the reflection of the own SRL behavior as a basis to get able to act as a positive role model who demonstrates SRL behavior (Bandura, 1977), and second the development of knowledge concerning the support of SRL in kindergarten children.

Promotion of SRL

To conceptualize an adequate training for kindergarten teachers to improve SRL in children of kindergarten age, psychological-developmental requirements have to be considered. It is still unclear if and how many (meta-)cognitive conditions for SRL have already been developed by five to six-year-old children. While some authors like Veenmann, Van Hout-Wolters and Afflerbach (2006) postulate that metacognitive abilities that are necessary for SRL are not developed until school age (about eight years), others assume that basic abilities for controlling and regulating one's own cognitive processes already exist by preschool age (see Bronson, 2000; Hoyle & Dent, 2018; Larkin, 2010; Whitebread et al., 2009). By the means of extensive observational studies, Bronson (2000) could show that children of preschool age increasingly acquire capacity for information processing that enables them to adequately understand task demands. In addition, the capacity of working memory which facilitates the remembrance of instructions and therefore serves as a useful help to pursue defined goals, already increases in childhood (Hoyle & Dent 2018). Furthermore, at kindergarten age, intrinsic motivation is still highly developed, which contributes to a facilitation of the maintenance of learning-action (Carlton & Winsler, 1998). In addition, five to six-year-old children already possess the basic abilities to monitor and execute volitional control over their learning actions, which are necessary to finish a task in accordance with the initially established aims (Zimmerman, 2000). Furthermore, the ability to inhibit impulsive responses in favor of goal-directed responses, named effortful control, has already been developed at the age of three (Hoyle & Dent, 2018). These results indicate that at least basic developmental-psychological abilities to learn self-regulation already exist, making a targeted promotion of SRL at the end of kindergarten possible and meaningful. Certainly, essential reference persons such as parents or early childhood educators can mainly support the learning processes of children in this age group and therefore have an important role in terms of the development of SRL (see Hoyle & Dent, 2018; Pino-Pasternak & Whitebread, 2010). Concrete strategies to promote SRL in children were formulated within the parental Inducement of Self-Regulation-model (PIASR) by Martinez-Pons (1996), which formed the theoretical basis of the intervention concerning strategies to promote SRL. This model seemed suitable as it had already been successfully implemented in a previous study concerning the promotion of SRL in younger children through an intervention for kindergarten teachers (Perels et al., 2009). The model was originally conceptualized with regard to supporting behaviors of parents, but in the study of Perels et al. (2009), it was assumed that the model can also be transferred to kindergarten teachers because they take on the education-

al task while also acting as a positive role model. Therefore, it is to be expected that the SRL promotion strategies based on the PIASR model of Martinez-Pons (1996) can be used by kindergarten teachers, too. The model is defined by four central dimensions (modeling, encouragement, facilitation and rewarding). These dimensions represent strategies that adults can use to support the SRL of children and were mediated and practiced in the present indirect intervention. Based on the assumptions of Bandura (1977), the dimension of modeling comprises behaviors of adults who display positive examples of SRL and which are hypothesized to be imitated by children if they witness them regularly in everyday life (see Martinez-Pons, 1996). Encouragement means the ability to strengthen the child's efforts to imitate the observed behaviors adequately. Ongoing encouragement is assumed to lead to higher motivation and thus an improved persistence while task processing as well as more frequent mastery of the task. The dimension of facilitation in Martinez-Pons' model represents parental behaviors that contribute to mastery of a task by offering little encouragement such as targeted steering of attention to the essential dimensions of the task (Martinez-Pons, 1996). Finally, the dimension of rewarding contains parental behaviors that are intended to influence the children's behavior by providing rewards if the children show SRL strategies. In behavioristic terms (e.g., Skinner, 1974), it is likely that a behavior which is rewarded will be displayed more often. The model provides a basis for the procurement of knowledge of strategies that early childhood educators can use in their everyday working life to foster SRL in children.

Interventions to Promote SRL and SRL Promotion Strategies

Several studies confirm the effectiveness of direct interventions, meaning interventions that are directly attached to the target group, (e.g. Glaser & Brunstein, 2007; Perels, Gürtler, & Schmitz, 2005) as well as indirect interventions (De Jager, Jansen, & Reezigt, 2005; Perels et al., 2009; Souvignier & Mokhlesgerami, 2006), meaning interventions that focus on the environment of the target group. In their meta-analyses, Dignath, Buettner and Langfeldt (2008) examined 48 SRL programs in the primary school context in regard to their effectiveness. The results showed positive effects on academic performance (d= .62; $S.E$= .05), cognitive and metacognitive strategy use (d= .73; $S.E$= .04) and motivation (d= .76; $S.E$= .09). Therefore, especially the promotion of strategy use and motivation seems to be fruitful in primary school age (Dignath, Buettner, & Langfeldt, 2008). Studies in a school context were often developed with the aim to offer teachers material that they can use in their classes to support the SRL of their students (e.g., DeCorte, Verschaffel, & Van de Ven, 2001; Fuchs et al., 2003; Perels, Dignath, & Schmitz, 2009). Some interventions are conceptualized as professional development programs for teachers on the subject of SRL and revealed positive effects for the students (e.g., De Jager, Jansen, & Reetzig, 2005; Rozendaal, Mineart, & Boekaerts, 2006). In combination with an intervention for children of primary school age, Otto (2007) developed an indirect intervention concerning the promotion of SRL by teachers and parents. As part of the indirect intervention, knowledge about SRL processes and strategies concerning the promotion of SRL in class and in homework situations were mediated. The results of the study revealed significant improvements in terms of SRL on the level of the children, particularly in the training conditions where children took part in the intervention instead of only the teachers and/or parents. In elementary context, direct as well as indirect interventions are still rare (Perels et al., 2009), but first approaches have been launched in the recent years that have proven to be effective. One example of a direct intervention in a preschool context was developed by Perels and colleagues (2009). The intervention aimed to support the development of SRL strategies in preschoolers by practicing them together on the basis of various playful and creative tasks.

In kindergarten context, indirect interventions, meaning interventions that are aligned to the environment of the target group (e.g. parents or educators of children) seem to be of special interest because essential reference persons like parents or kindergarten teachers still have a formative influence on the behavior of the target age group (Bruder, 2006). Indirect interventions also offer the advantage of increased efficiency because kindergarten teachers in particular can operate as multipliers of the mediation of SRL skills (Bruder, 2006). Despite these obvious benefits of training essential reference persons in a kindergarten context, there is still a lack of research concerning SRL promotion interventions that are explicitly aimed at essential reference persons of children at the end of kindergarten time. One of the rare indirect intervention studies concerning the promotion of SRL in a preschool context was developed by Perels et al. (2009). Besides promotion of the preschoolers' SRL within the direct intervention (described above), the study aimed at imparting opportunities for the targeted promotion of SRL by preschoolers and a self-reflective conceptualization of SRL in a three-weekly training. Results were obtained for the preschool teachers as well as the children. On the level of the preschool teachers, significant improvements concerning their own SRL were revealed. The children showed significant benefits of the training in terms of their SRL.

The EMIL-project represents another example of a successfully evaluated study with the subject of an indirect promotion of executive functions in preschoolers (a construct nearly related to SRL) by providing a further education program for early childhood educators (Walk, Evers, Quante, & Hille, 2018). The training program includes a total of eight sessions in which knowledge about executive functions is mediated and ways to support it in preschoolers in the daily routines of the preschools are developed and discussed. The evaluation of the intervention yielded significant benefits of the training on the level of the preschool children with regard to three of seven executive function tests, namely behavioral inhibition, visual-spatial working memory, and combined executive function (working memory, inhibitory control, and cognitive flexibility). Results of the evaluation of the training on the level of the educators are not known so far.

Although it is becoming apparent that the promotion of self-regulation in kindergarten is gaining importance in both contexts, research and practice, there is a lack of interventions that include kindergarten teachers and parents together although the highest effect on the SRL of preschoolers can be expected if both reference groups are trained. By training parents and early childhood educator together, a consistent promotion at home and in kindergarten – the two most important learning contexts of kindergarten-age children – is ensured (El Nokali, Bachmann, & Votruba-Drzal, 2010).

SRL Promotion Strategies and Teachers' SRL Behavior

In terms of the importance of the SRL behavior of teachers for the implementation of SRL promotion strategies, empirical research seems to provide consistent results. In his study, Randi (2004) concluded that "teachers advance their knowledge and are enabled to recognize more opportunities to foster self-regulation in a diversity of settings" (Randi, 2004, p. 1966), if they are given opportunities to improve their own SRL. Following this assumption, teach-

ers first need to be conscious of their own SRL behavior before they can transfer adequate strategies to children. On the basis of their research, Peeters et al. (2014) also highlighted the "teacher's own self-regulatory competencies as a critical determinant of SRL implementation in primary school" (Peeters et al., 2014, p. 1963). In accordance with the assumptions of Peeters et al. (2014), Kramarski (2018) also supposes a dual teacher role in the context of SRL in his theoretical model, namely the learner's role and the teacher's role. Considering this dual role of teachers, the kindergarten teacher training that built the empirical basis for the investigation of differential effects, followed a two-level approach. In each session, methods to reflect and optimize the SRL behavior of the kindergarten teachers themselves were mediated while at the same time strategies to support the development of SRL in kindergarten children were presented and discussed within the training. Due to these conceptual thoughts and empirical findings, the present study also wanted to examine differential effects in terms of the SRL behavior of the participants.

Differential Effects When Fostering SRL Promotion Strategies

When evaluating interventions in real-life settings, the consideration of differential effects plays an important role because "the evaluator cannot influence the general set-up" (Lapka, Wagner, Schober, Gradinger, & Spiel, 2011), meaning that often a natural heterogeneity of the training group is given that is beyond the control of the evaluator. Therefore, within a training sample, it can be assumed that there are individual differences, such as regarding different starting levels concerning the main teaching subject, which can lead to different benefits of a training (Lapka et al., 2011). By using a variable-oriented approach, these individual differences are neglected, and only global effects of the training can be revealed. However, with the help of a person-centered approach, as implemented in the present study, changes through the training in relation to special subgroups can be analyzed. In this way, one can identify the need for the development of adaptive trainings that consider claims and needs of different subgroups. Thus, research on differential training effects can contribute to a profound foundation of individual trainings. In a study by Dörrenbächer and Perels (2016), SRL profiles of college students that differed qualitatively with regard to motivational subcomponents were examined to determine the effectiveness of a training to improve SRL skills. The results revealed that students within the profile with moderate SRL benefited from the intervention, whereas students with low SRL and moderate motivation as well as students with high SRL and high motivation did not show significant change. Another example of an investigation of differential effects of a training concerning the knowledge and usage of SRL strategies is a study by González-Pienda, Fernández, Bernardo, Núñez and Rosário (2014) that considered different pre-training SRL levels within the evaluation of their training. The results of their study illustrated that students with low baseline levels profited, whereas students with moderate and high baseline levels did not benefit noticeably. One explanation for this compensation effect is that students who already possess a high level of SRL skills have little room for improvement, whereas students with low levels of SRL skills can take the opportunity to expand their knowledge and practice the newly learned strategies through training. Results from other studies (e.g., Alexander, Carr, & Schwanenfluegel, 1995) indicate a contrary effect, named the Matthew effect (Walberg & Tsai, 1983), meaning that participants who already start with a high level of knowledge profit more from an intervention. This increased gain is explained by their superiority in controlling cognitions, which leads to a facilitated learning and application process. In a meta-analysis by Donker, Boer, Kostons, Dignath van Ewijk and van der Werf (2014), a total of 58 studies on learning strategy instructions in primary and secondary education with a focus on improving SRL were examined with the aim to reveal the strategies that can best contribute to an improvement in academic achievement. They also investigated differential effects of learning strategy instructions in reference to different types of students (regular students, children from low SES background, children with learning disabilities and needs and gifted children from higher SES backgrounds). In contrast to the studies described above, which suggested either a compensation effect or Matthew effect, the results of the analysis by Donker et al. (2014) did not reveal any significant differences between the individual types of students in regard to their gains from strategy instruction.

To summarize, the current research literature offers inconsistent findings concerning the benefit of a SRL (strategy) training for different groups of participants. In addition, analyses of the differential effects of interventions with the focus on SRL promotion strategies in a kindergarten context are very rare, so the present study can provide new insights into this field of research. Considering the preceding theoretical and empirical findings, a suitable training can only be provided, if different competencies and prior levels of knowledge are taken into consideration. This is why the present study aimed to evaluate a SRL training for kindergarten teachers, using different promotion strategy profiles. Given that the present study is most similar to the González-Pienda et al. (2014) study, it was hypothesized that kindergarten teachers with a low SRL promotion strategy profile would benefit more from the intervention than kindergarten teachers with a high SRL promotion strategy profile, indicating a compensation effect.

The Current Study

The preceding explanations show gaps in the research, the present study hopes to fill. First, there is a large amount of research concerning the promotion of SRL in a school context, referring to teachers, but the extent of knowledge and the usage of concrete strategies to foster SRL of educational staff in kindergarten have been largely neglected thus far. As a consequence of the increased recognition of early education processes and their support by kindergarten teachers, the conceptualization and evaluation of a specific SRL promotion training for this professional group, is of great significance. This was the starting point for the development and evaluation of a study for kindergarten teachers which aimed to improve their knowledge and competencies in regard to the promotion of SRL in children of kindergarten age (Venitz & Perels, 2018; further described in section 2.2). The results of the quasi-experimental control-group study with repeated measures showed a significant increasement in terms of the strategies that were used by the participants to promote the SRL in children of kindergarten age (Venitz & Perels, 2018). However, an investigation of differential effects is still pending, although it has been shown that the analysis of effects in dependence of different participant groups, offers a deeper insight into the evaluation of an intervention (Lapka, et al., 2011). In conclusion, this is why the present study now aims to investigate whether kindergarten teachers with specific SRL promotion strategy profiles displayed differential training effects. Consequently, the first aim of the present study was to investigate different profiles concerning SRL promotion strategies within the group of kindergarten teachers (Research question 1). Second, the training effects of a previously developed intervention for kindergarten teachers on the subject of promoting SRL in children of kindergarten age (Venitz & Perels, 2018) in relation to the different SRL promotion strategy outbound profiles were investigated (Research question 2).

Methods

Sample

Data from the present study were collected as part of a study supported by the German Research Foundation in the period from September 2014 to August 2015.

Sample for Research Question 1

In all, 134 German kindergarten teachers (96.6% female) took part in the test consisting of a questionnaire to assess SRL and strategies to promote SRL. This data formed the basis for the conduction of latent profile analyses on SRL promotion strategies. Of the kindergarten teachers, 11.5% were under 25 years, 17.5% were 25-29 years old, 13.5% were 30-39 years, 18.8% were 40-49 years, 33.3% were 50-59 years and 5.2% were over 60 years old. They had been employed in their roles for 17.5 years on average (SD = 13.76). Because we used this sample to conduct latent profile analysis, it was named the cluster sample.

Sample for Research Question 2 (Differential Training Effects)

For the analysis of differential training effects, n = 76 kindergarten teachers (100% female) were recruited. They participated in a SRL promotion training for children at the age of five to six years (see below) and had completed both a pretest and posttest. Of the kindergarten teachers, 13.5% were under 25 years, 21.2% were aged 25-29 years, 11.5% were 30-39 years, 19.2% were 40-49 years, 28.8% were 50-59 years and 5.8% were over 60 years old. They have been teaching for an average of 16.01 years (SD = 12.84 years). This sample was used to analyze individual effects of the SRL promotion strategy profiles with regard to the SRL intervention and thus termed the training sample.

Intervention to Promote SRL and SRL Promotion Strategies of Kindergarten Teachers

As a special feature of the training for kindergarten teachers, which was analyzed concerning differential effects in the present study, we used a two-level-approach that has been shown to be effective in previous indirect trainings in a school context (e.g., Bruder, Perels, & Schmitz, 2004). In order to transfer teachers' knowledge to children in kindergarten parallel to the intervention, the training pursued two essential aims: First, kindergarten teachers should be sensitized to the process of SRL in order to optimize their own SRL and therefore, to act as a positive role model (Bandura, 1977) for the children. Second, they should learn which methods they can use to support the development of SRL in kindergarten-age children (in reference to Martinez-Pons' PIASR-model, 1996). The data of the intervention study were collected in the period between September 2014 and August 2015 in several German kindergartens in a circuit of the responsible university. For the adult sample, 37 kindergarten teachers in the training groups and 10 kindergarten teachers in the control group participated in the study. Participation was voluntary, and data were collected anonymously. A unique assignment of the children to the parents and the kindergarten teachers was made possible by the procurement of individual codes. For the analyses on the child level, 53 children between five and six years were included. The training was comprised of three weekly sessions lasting about 90 minutes each and was conducted by two skilled trainers (see Venitz & Perels, 2018 for extended training description). To ensure standardized implementation, a schedule for each session was developed. All the sessions were structured in a similar way. At the beginning of each training session, the participants were greeted and made familiar with the contents of the day's training. After a theoretical lecture, the participants were offered the opportunity to practice parts of the learned content based on different exercises. After the exercises, they were encouraged to exchange experiences and examples of appropriate situations in their everyday life. At the end of each session, a transfer assignment was given to gain (further) experience either on the reflection of their own SRL or the teaching of self-regulatory strategies in their kindergarten classes until the next session. These experiences and related questions were renewed at the next training session. During every session, they also received a folder with materials for further exercises and an overview of the essential points of the training. The theoretical contents of the interventions propose a cyclical process, which can be divided into forethought, performance, and self-reflection phase (Zimmerman, 2000). In each of the three sessions, one phase and its central components and strategies were elaborated upon and heightened by exercises. Specific contents of the single sessions are displayed in Table 1.

Table 1. *Contents of the first, the second and the third training session*

First Training Session	Overview of the training units by means of a short theoretical input (the model of self-regulation by Zimmerman (2000) and PI-ASR-model by Martinez-Pons (1996) Forethought Phase Relevance of adequate goal formulation (theoretical input, interactive group exercise
Second Training Session	Performance Phase Strategies to support task processing, e.g. support in handling distractions (theoretical input, self-reflection exercise) Importance of children's self-talk while task managing and the method of metacognitive dialog (Pramling, 1988)
Third Training Session	Self-reflection Phase Relevance of attributing styles for the development of children's attitudes towards learning (theoretical input, self-reflection exercise) Importance of supporting beneficial reference standard (theoretical input, group exercise) Mistakes as an opportunity for the further development of learning processes (theoretical input)

Measures

To assess kindergarten teachers' self-reported knowledge about SRL promotion strategies and their perception of their own SRL behavior, a questionnaire was used, consisting of 146 items. The 4-point Likert-type scale ranged from 1 ("I don't agree at all") to 4 ("I agree completely"). In terms of the knowledge about SRL promotion strategies, the questionnaire comprises four subscales (modeling, facilitation, encouragement and rewarding) based on the PI-ASR-model (Martinez-Pons, 1996). They all showed acceptable internal consistency values for the two measurement points (see Table 1). To assess the kindergarten teachers' perceptions of their own SRL, three subscales (forethought phase, performance phase and self-reflection phase) in reference to Zimmerman's model of self-regulated learning (2000) were used, which showed satisfying Cronbach's alpha values (see Table 1). The scores Self-regulated learning behavior overall and SRL promotion strategies overall were used for the investigation of differential training effects and revealed good internal consistencies for both measurement points (see Table 2).

Table 2. *Scales, item examples, and reliabilities of the questionnaire*

		Cronbach's alpha	
Scale	Subscale	T1	T2
SRL behavior	Forethought phase: e.g., "Before I start a task, I am setting concrete targets." (36)	.90	.91
	Performance phase: e.g., "While I am working, I am thinking of my set aims, to check if I made progress." (19)	.73	.76
	Self-reflection phase: e.g., "Errors show me, what I can do differently." (17)	.79	.75
SRL promotion strategies	Modeling: e.g., "If I am excited about something, it automatically promotes the motivation of the children." (10)	.73	.69
	Facilitation: e.g., "If the children have difficulty solving a task, I try to encourage them to find their own solutions." (15)	.77	.81
	Encouragement: e.g., "If the children are afraid of a task, I encourage them." (10)	.77	.82
	Rewarding: e.g., "I praise the children for tracing failures to changeable things." (5)	.72	.52
Self-regulated learning behavior overall		.92	.93
SRL promotion strategies overall		.86	.74

Data Analysis

To answer Research Question 1, we wanted to analyze individual differences in the self-reported knowledge about SRL promotion strategies of kindergarten teachers. With the help of latent profile analyses (see Vermunt & Magidson, 2002) of the cluster sample of 134 kindergarten teachers using the SRL promotion strategy subscales (see Martinez-Pons, 1996) as indicators, we grouped them into homogenous classes. We choose latent profile analyses because they can be used with continuous variables and they contribute to the identification of latent classes on the basis of the relationships of the indicator variables. Thus, participants with similar characteristics in terms of the indicator variable are grouped together and are defined by the other groups from which they differ in regard to the variable of interest. As the research suggests that teachers differ in terms of the level of strategies they use to promote SRL in children, we could expect different SRL promotion strategy profiles for kindergarten teachers but did not know how many profiles existed. Therefore, we conducted an exploratory analysis by investigating models from 1 to 7 classes in MPlus7 (Muthén & Muthén, 2012), which uses the robust maximum-likelihood estimation approach (MLR). The number of initial stage random starts was set to 500 with a maximum of 50 iterations of the stages of the optimization. To handle missing data, MPlus uses the Full Information Maximum Likelihood algorithm. In order to determine the number of classes that best conformed to the data, several model fit criteria were considered. Following the recommendations by Marsh, Lüdtke, Trautwein and Morin (2009), Bayesian Information Criterion (BIC), entropy and the Lo-Mendel-Rubin Likelihood Ratio Test (LMRT) were used for model selection. A low BIC can be interpreted as an indication for a good model fit, whereas high entropy values suggest a better model fit. A significant p-value for the LMRT indicates that the estimated model with k-classes fits the data better than the model with k – 1 classes. In addition to goodness of fit indices, theory or previous research should be considered to help decide upon the best model (see Marsh, Lüdtke, Trautwein, & Morin, 2009).

To answer Research Question 2, the kindergarten teachers who took part in the SRL promotion strategy training were selected as the training sample. Based on this data, the aim was to identify differential training effects in dependence of SRL promotion strategy profiles. In accordance with the central aims of the intervention, repeated measurement analyses were conducted using overall SRL promotion strategy (mean of all item scores) and overall SRL behavior as dependent variables and the profile classification as the independent variable. We did not have to replace missing values, since for the cluster sample as well as for the training sample, they were completely random (Little's MCAR test revealed no significant results). In accordance with previous research (González-Pienda et al., 2014), we predicted that kindergarten teachers would differ in how their mean scores changed from pre- to posttest, namely that teachers with low SRL promotion strategy profiles would have a greater benefit from the SRL intervention than teachers with moderate or high SRL promotion strategy profiles. To test this hypothesis, additional theory-driven single group comparisons were conducted using contrast analyses.

Results

Research Question 1: Latent Profile Analyses

With the aim of grouping homogenous classes, we conducted latent profile analyses (LPA) with the SRL promotion strategy subscales as indicators using the cluster sample (n= 134).

The fit indices of the analyses for the 2-7 cluster group solutions are displayed in Table 3.

The latent profile analyses for kindergarten teachers' perceptions of their SRL promotion strategy knowledge resulted in a three-cluster solution, which is consistent with the results of the study by González-Pienda et al. (2014). The three-cluster shows the lowest BIC, good entropy and a significant p-value for the LMRT. In addition, the distribution of the classes is balanced (profile 1= 40; profile 2= 51; profile 3= 43). Although a two-class solution showed higher entropy and a significant p-value for the LMRT, it has a much higher BIC and the distribution of the teachers to the classes is less balanced, making a three-class solution preferable. Following the recommendations of Marsh et al. (2009), we investigated solutions using different numbers of groups, deciding to use the one "that makes most sense in relation to theory, previous research, the nature of the groups, and interpretation of the results" (Marsh et

al., 2009, p. 194). We considered these points in addition to goodness of fit indices. The fit indices, as shown above, support a three-class solution. In addition, the same number of classes was used in the study of González-Pienda et al. (2014), again supporting a three-class solution. Means and standard deviations of the SRL promotion strategy indicators (modeling, facilitation, encouragement, rewarding) as well as of the overall variable SRL promotion strategies are displayed in Table 4.

Table 3. *Fit statistics for latent profile analyses*

Cluster	*BIC*	*E*	*LMRT*
2	365.00	.82	.00
3	354.62	.80	.01
4	367.26	.79	.79
5	380.93	.80	.43
6	395.46	.83	.25
7	408.32	.81	.36

Note. *BIC*= Bayesian information criteria, *E*= entropy, *LRMT*= p-value for Lo-Mendell-Rubin test. The selected cluster solution is typed in boldface.

Table 4. *Means and standard deviations of the tested variables in dependence of the SRL promotion strategy profile*

Groups	*n*	*M (SD) MDL*	*M (SD) FCL*	*M (SD) ENC*	*M (SD) REW*	*M (SD) SRL_PS*
Low SRL promotion strategy Profile	40	3.06 (.28)	3.04 (.18)	3.18 (.14)	3.00 (.37)	3.07 (.12)
Moderate SRL promotion strategy profile	51	3.21 (.39)	3.14 (.23)	3.62 (.14)	3.14 (.44)	3.31 (.14)
High SRL promotion strategy profile	43	3.61 (.31)	3.61 (.17)	3.85 (.12)	3.63 (.37)	3.70 (.10)

The profile plot (Figure 1) illustrates specific characteristics of the SRL promotion strategy profiles. The differences in the means of the subscales were significantly different for all groups (p< .00).

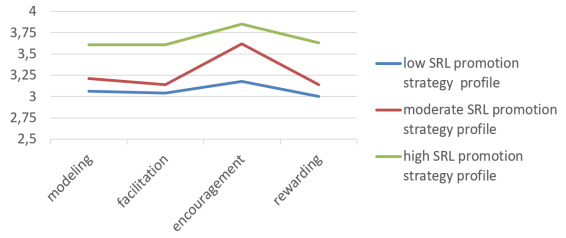

Figure 1. Profiles of SRL promotion strategies for Group 1 (low SRL profile), Group 2 (moderate SRL profile) and Group 3 (high SRL profile)

The means of the SRL promotion strategy subscales are all located in the upper third of the graph (M= 3.03-3.85, scale from 1 "I don't agree at all" to 4 "I agree completely"), meaning we can conclude that all kindergarten teachers already had some knowledge of SRL prior to the intervention. In addition, all profiles show a similar distribution in terms of the subscales, indicating they all had the highest scores for the subscale encouragement and lower values for the subscales modeling, facilitation and rewarding. It can be concluded that the classes do not differ obviously in terms of the distribution of the values on the subscales but rather in regard to their height. Class 1 had the lowest scores for all subscales, so it was named "low SRL promotion strategy profile" (blue line). Class 2 had moderate scores and therefore was termed the "moderate SRL promotion strategy profile" (orange line), and Class 3 showed the highest scores for all subscales of the SRL promotion strategies, so we named it the "high SRL promotion strategy profile" (grey line).

Research Question 2: Differential Training Effects

To ensure that the cluster and the training group shared the same baseline, the distribution of the detected SRL promotion strategy profiles in the cluster and the training group was checked for uniformity. Next, we again conducted a latent profile analysis with Mplus (Muthén & Muthén, 2012) within the training group (n= 76 kindergarten teachers). Table 5 displays the fit indices of the analyses for the 2-7 training group solution.

Table 5. *Fit statistics for latent profile analyses*

Cluster	*BIC*	*E*	*LMRT*
2	143.45	.83	.00
3	**130.42**	**.85**	**.04**
4	139.49	.89	.10
5	143.20	.91	.05
6	154.79	.90	.48
7	164.24	.92	.10

Note. *BIC*= Bayesian information criteria, *E*= entropy, *LRMT*= p-value for Lo-Mendell-Rubin test. The selected cluster solution is typed in boldface.

In this case, the LPA for the training group also resulted in a three-cluster solution showing the lowest BIC, good entropy and a significant p-value for the LMRT. Participants were distributed into the classes as follows: Profile 1= 31; Profile 2= 27; Profile 3= 18.

To investigate how the different profile groups' knowledge concerning SRL promotion strategies changed through the intervention, a repeated-measurement ANOVA with overall SRL promotion strategies (mean of all item scores) as dependent variable (pretest/posttest) and profile groups as independent variable was performed. We wanted to detect interaction effects of profile groups with time. Due to the small sample size, we conducted Kolmogorov-Smirnov-tests for overall SRL strategy profiles (T1, T2) of all three groups. The results showed no significant deviation from normal distributions that would prohibit conducting an ANOVA. With the help of a 2 x 3 (time x SRL promotion strategy profile) repeated-measurement ANOVA, we found a significant interaction (F(2,73)= 3.16, p< .05, η_p^2= .08), indicating differential effects in terms of the SRL promotion strategies with regard to SRL promotion strategy profiles. The changes in terms of the SRL promotion strategies between the two measured time points are displayed in Fig 2.

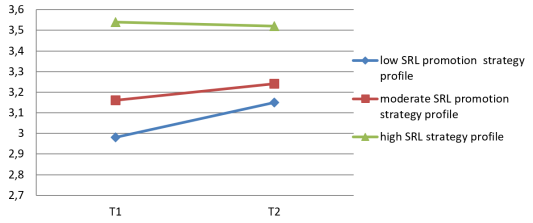

Figure 2. Differential training effects in terms of teacher self-regulated learning behavior in dependence on SRL promotion strategy profile group. Scale from 1 [not true at all] to 4 [totally true]

Differential Effects in terms of SRL behavior

We also ran a repeated-measurement ANOVA with overall SRL behavior (mean of all item scores) as the dependent variable (pretest/posttest) and profile groups as the independent variable to investigate whether there were significant interaction effects of profile groups with time.

Additionally, we again conducted Kolmogorov-Smirnov tests for overall SRL behavior profiles (T1, T2) of all three groups to account for the small sample size. The results showed no significant deviation from normal distributions that would contraindicate the use of ANOVA. The results of the 2 x 3 (time x SRL behavior) repeated measurement ANOVA showed a significant interaction, $F(2,73)= 3.20$, $p< .05$, $\eta_p^2= .08$, indicating differential effects in terms of teacher SRL behavior with regard to SRL promotion strategy profiles. The changes in terms of the teacher SRL behavior between T1 and T2 are displayed in Fig 3.

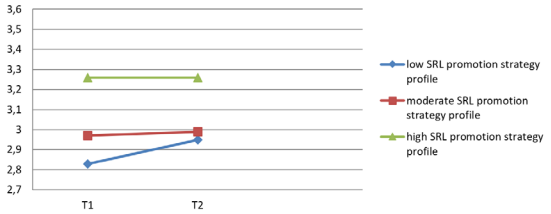

Figure 3. Differential training effects in terms of teacher self-regulated learning behavior in dependence on SRL promotion strategy profile group. Scale from 1 [not true at all] to 4 [totally true]

Low versus high SRL promotion strategy profile

To test the hypothesis that kindergarten teachers with a low SRL promotion strategy profile benefit more from training than teachers with a high SRL promotion strategy profile (high SRL promotion strategy profile > low SRL promotion strategy profile), we ran theory-driven single-group comparisons by the means of contrast analyses. The values of the second measurement of the dependent variable were considered for the analyses. As a measure of the effect size, Cohen's *d* was used. Following Cohen (1988), effect sizes of $d\geq .25$ are considered small, $d\geq .50$ medium, and $d\geq .80$ a large effect.

The results of the contrast analyses in terms of the SRL promotion strategies (overall value) were significant ($t(2,73) = 4.82$, $p< .001$, $d= 1.51$). In terms of the teachers' SRL behavior, contrast analyses also revealed significant results ($t(2,73)= 4.53$, $p< .001$, $d= 1.22$).

According to Cohen (1988), the determined effects can be interpreted as large effects.

Discussion

Following a person-centered approach, we had two essential aims: First, we wanted to examine whether there are different profiles among kindergarten teachers in regard to their self-reported knowledge of SRL promotion strategies. Secondly, we investigated differential training effects by testing the hypothesis that kindergarten teachers who possess only a low knowledge level of SRL promotion strategies benefit more from a SRL training than kindergarten teachers who already have greater knowledge about SRL promotion strategies before the intervention. The latent profile analyses revealed the presence of three profiles of SRL promotion strategies, characterized as low, moderate and high level. The first profile, "low SRL promotion strategy profile" (29.85%) represented the smallest group of the three. Most kindergarten teachers in this study belonged to the second profile: "moderate SRL promotion strategy profile" (38.81%). 31.34 % of the participants were assigned to the "high SRL promotion strategy profile". Overall, all groups showed rather high values on the subscale encouragement, indicating that they already had a sense of the importance of positive reinforcement for child learning and already used this strategy in their daily work in kindergarten. However, the recognition of the importance of rewarding and facilitation was rated rather low by the participants. One explanation for the poor recognition of rewarding as a strategy to improve SRL in children might be that it has a somewhat negative connotation in society because it is often stated that rewarding leads to spoiling. Nevertheless, rewarding, in form of the recognition of successful learning actions and behaviors by adults, is an essential motivational factor for children and therefore can help to improve SRL. This assumption is supported by several empirical findings (e.g., Henderlong & Lepper, 2002). In Henderlong and Lepper's 2002 review of the effects of praise on children's motivation, they showed that praise can have different effects on intrinsic motivation depending on a series of variables. In their synthesis, they conclude that, when praise is insincere, related to ability or perceived as controlling, it diminishes children's intrinsic motivation. In contrast, sincere praise contributes to positive performance attributions and therefore increased intrinsic motivation and effort. Concerning the lower scores for facilitation, it can be assumed that the kindergarten teachers did not recognize the importance of this strategy as much as with regard to encouragement. However, facilitation is probably one of the most effective strategies for promoting children's SRL as it is an integral aim of theoretical approaches like for example the model of Martinez-Pons (1996), the metacognitive dialogue of Pramling (1988) or the sustained shared thinking by Siraj-Blatchford et al. (2002). With regard to research aim 1, the results revealed that kindergarten teacher significantly differ in terms of their knowledge about SRL promotion strategies. In reference of the aptitude-treatment-interaction approach (Snow, Corno, & Jackson, 1996), it can be assumed that the detected subgroups of participants have different needs and wishes in regards to the training. Therefore, the intervention might not be equally fruitful for all participants which was tested by Research Question 2.

In terms of this second Research Question, the present study revealed that kindergarten teachers with low SRL promotion strategy profiles benefited significantly of the indirect intervention, whereas kindergarten teachers with high SRL promotion strategy profiles did not. The findings suggest a compensation effect, which was also found in the study by González-Pienda et al. (2014). The fact that only kindergarten teachers with a low SRL promotion strategy benefited from the intervention indicates that a SRL promotion strategy training may not be equally effective for all kindergarten teachers. Prior knowledge has to be considered because they can influence the effects of instructional designs (Lapka et al., 2011). Consequently, adaptive trainings that are tailored to the different needs of the detected classes are required. Considering the high SRL promotion strategy profile, the training should be revised. The results illustrate that the teachers already possess a high level of knowledge of SRL promotion strategies, so it would be useful to shift the focus from a mediation of basic knowledge to a more practical approach which focusses on minimally guided problem-solving (Kalyuga, 2007). Building on Fyfe, Rittle-Johnson and DeCaro (2012) who investigated effects of different levels of guidance during exploratory mathematical problem solving for children, it can be assumed that the participants with a high SRL level prior to the intervention benefit more from independent learning methods that they can adapt

to their unique learning needs. However, participants with less knowledge need more intensive instructional support in order to improve (Kalyuga, 2007).

Limitations and Implications for Future Research and Practice

Although the study offers differential insight into the promotion of SRL from the perspective of kindergarten teachers, several aspects should be optimized in future studies. One obvious limitation of the study is that all variables have been assessed by means of self-report even though research on the assessment of SRL has shown that what people report doing or thinking does not always correspond to their actual behavior (see Veenmann, 2005). In our study, this means that participants may indicate that already know many SRL promotion strategies (e.g., because of social desirability) although they do not use them in daily practice, thus distorting the results of our analyses. Therefore, in future studies, questionnaires based on self-report should be complemented by online measures such as think-aloud protocols or systematic observation. A suitable possibility for supplementing self-reports seems to be the observation instrument ATES (Assessing How Teachers Enhance Self-regulated Learning; Dignath-van Ewijk, Dickhäuser, & Büttner, 2013) which assesses teachers' promotion of SRL in capturing their instruction of SRL strategies.

Another limitation of the study is the small sample size, particularly of the training sample. To obtain valid conclusions for different training effect sizes, further studies with larger sample sizes would be meaningful. In addition, an investigation of the long-term effects would be interesting to make causal inferences possible.

Generally, the study contributed to a more in-depth insight into the knowledge of kindergarten teachers concerning the promotion of SRL, a theme which has been neglected for some time despite the increasing interest in the SRL of students (Dignath-van Ewijk, 2016). The evaluation of the training through a person-oriented approach showed that kindergarten teachers who belonged to the high SRL promotion strategy profile did not benefit from the intervention, leading to two essential implications for future research and practice. First, differential effects have to be further investigated by integrating additional variables. Here, the consideration of motivational aspects seems to be useful since motivation can impact the effectiveness of a training (Chiaburu & Tekleab, 2005; Jaeggi et al., 2011; Scaduto, Lindsay, & Chiaburu, 2008). Therefore, it could be assumed that the high SRL promotion strategy group benefits less because they already possess much of the knowledge shared during the intervention and therefore were less motivated to pay attention. A decrease in motivation and related attention to presented material could have hampered the absorption of new knowledge. Second, based on the findings referring to differential effects of the intervention, an adaption of future trainings is required. The results indicate that kindergarten teachers with high and with low prior knowledge concerning SRL promotion strategies do not benefit equally from the training. Taking these differences into account, trainers will be able to adapt their teaching methods and to select materials that are tailored to the requirements of the subgroups. Whereas kindergarten teachers with a poorer knowledge of SRL promotion strategies seem to need more instructional support, for participants with higher knowledge the focus should be placed on more independent learning methods and a more practical and problem-solving oriented approach.

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Improving Metacognitive Abilities As An Important Prerequisite for Self-Regulated Learning in Preschool Children

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Abstract

Metacognition is a crucial prerequisite for self-regulated learning and refers to the knowledge and the regulation of cognitive processes. Several authors argue that children at preschool age can use initial metacognitive control strategies and monitor their learning activities. This fact will create the conditions for promoting metacognitive activities at an early stage. The development of these activities at this age is influenced by several contextual factors, such as home or school environments. Essential caregivers exert a strong influence in terms of the development of metacognitive abilities. In view of this above 137 children participated in an intervention study aiming to improve metacognitive skills, along with their important caregivers such as parents and kindergarten teachers. Training concepts were designed that combined different kinds of interventions: a direct age-appropriate training of the preschoolers and two indirect interventions catered to parents and kindergarten teachers. The aim of this study was to analyze which training condition is more effective in improving metacognitive skills. We assumed that preschoolers who are consistently supported in their self-regulated learning in kindergarten and at home would benefit the most. Based on our data, we could partly confirm this hypothesis.

Keywords: Self-Regulated Learning, Metacognition, Monitoring, Control, Preschool Age

Introduction

The importance of self-regulated learning in early childhood was emphasized by several studies such as the longitudinal national cohort study Pre-COOL (Mulder, Hoofs, Verhagen, & Lesemann, 2014) or the Effective Provision of Pre-School Education (EPPE) project (Sylva, Melhuish, Sammons, Siraj-Blatchford, & Taggard, 2004). The ever-growing amount of knowledge available to humans makes it necessary to learn strategies to acquire new information and to adapt existing knowledge to new requirements in life. In this context, self-regulated learning, described as the ability to initiate, regulate, and reflect on activities independently (see Zimmerman, 1989; 2000), is one of the most important learning competencies (Zimmerman, 2013). It has also become apparent that self-regulated learning is predictive for future academic performance in several subjects (e.g. Blair & Razza, 2007; Hidi & Ainly, 2008; Perels, Dignath, & Schmitz, 2009). In addition, the importance of early childhood education is highlighted by further studies (e.g., Starting Strong, see Moss, Krenn-Wache, Na, & Bennett, 2004). Consequently, fostering self-regulated learning as early as possible is especially important because during their first years, children develop learning abilities (De Corte, Verschaffel, & Op´t Eynde, 2000; Hendy & Whitebread, 2000). These learning abilities, once established, are very difficult to change. Given the increasing importance of autonomous acquisition and adaptation of knowledge, children should become competent and independent actors actively regulating their own development and learning behavior. In that regard, some authors claimed that metacognition is a key aspect of self-regulated learning and they underline the importance of the monitoring and control processes, which are necessary for self-regulated learning (Winne, 2001; Winne & Hadwin, 2008). In general, metacognition is defined as higher-order thinking – as well as understanding, analyzing, and control – of cognitive processes (Flavell, Miller, & Miller 2002). Due to the relevance of self-regulated learning and especially metacognitive competences, the aim of this study is to improve young children's metacognitive abilities, namely their monitoring- and control activities (Winne & Hadwin, 2008).

Self-regulation and Self-regulated Learning

In general, self-regulation is defined as the ability to initiate, regulate, and reflect activities independently (see Zimmerman, 2000). Transferring the construct of self-regulation to the academic context, it is called self-regulated learning. Self-regulated learning can be defined as an 'active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate, and control their own cognition, motivation, and behavior, guided and constrained by their goals and the contextual features of the environment" (Pintrich, 2000, p. 453). Therefore, self-regulated learning is characterized by the continuous adaptation of one's own learning behavior, indicating in the independent planning, monitoring and regulating of one's own learning activities (Veenman & Spaans, 2005).

Self-regulated learning is based on a mutual interaction between three components: motivation, cognition, and metacognition (see for instance Adagideli, Saraç, & Ader, 2017; Dinsmore, Alexander, & Loughlin, 2008). These components affect the success of learning and are considered context-related (see Zimmerman, 2000). In the context of the three components, motivation refers to task selection and the initiation of the task performance as well as the effort and persistence during the task performance. This includes activities that serve as initiations of learning (e.g., self-motivation) and maintenance of learning processes (e.g. volitional control) as well as the attribution of success and failure and self-efficacy beliefs (see Corno, 2013; Dörrenbächer & Perels, 2015; Dweck, 2006; Pintrich, Wolters, & Baxter, 2000; Winne, 2001). The cognitive component is to be understood as conceptual and strategic knowledge as well as the ability to apply corresponding strategies (Butler, Perry, & Schnellert,

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2017; Winne, 2018). Another important prerequisite for self-regulated learning is the metacognitive component. This term refers to the knowledge and the regulation of one's own cognitions and thus includes the observation and assessment of one's own acting and thinking (see Flavell, 1979). In accordance with the definition of self-regulation processes and the current process models (e.g. Zimmerman, 2000), self-regulated learning is characterized by the processes of planning, monitoring, regulating and evaluating one's own learning activities (Winne & Hadwin, 1998; Zimmerman, 2001). In other words, metacognition is necessary for the whole self-regulated learning process. Therefore, the focus of this study will primarily be on metacognitive activities.

Metacognition

As mentioned above, metacognition is subdivided into knowledge and regulation (Larkin, 2010; Özsoy, Memiş, & Temur, 2017). In this sense, metacognitive knowledge refers to general knowledge about how people learn and process information, while metacognitive regulation involves the regulation of cognition and learning experiences and helps people control their own learning processes (see Livingston, 2003). Knowledge and regulation are not to be regarded as independent subcomponents. Rather, they are two interacting components of a super-ordinated regulation unit. To define metacognition there are many different approaches (Larkin, 2010; Livingston, 2003).

One well-known approach that has been used frequently as a basis for research on metacognition is the model of procedural meta-memory laid out by Nelson and Narens (see Mazzoni & Nelson, 2014; Nelson & Narens, 1990; 1994). Nelson (1996) simplified the metacognitive concept by defining metacognition as an exchange between two levels, an object-level and a meta-level (see also Mazzoni & Nelson, 2014). Whereas the object-level represents the information storage, the meta-level shows a superordinate authority. These levels are interlinked by two processes: First, the object-level provides the meta-level with information allowing for an assessment of the conditions (at the object-level) (monitoring). Monitoring also allows observation and reflection of one's own cognitive processes and gives some information on the current state of the cognition in relation to the actual goal (see Mazzoni & Nelson, 2014; Nelson & Narens, 1994). Second, the object-level is controlled by the meta-level, i. e. the management of information intake into the object-level (control). Control subsumes all the processes that describe the influence of the meta-level on the object-level. It refers to both conscious and unconscious decisions based on the results of monitoring activities. Control processes may be reflected through observable learning behavior. Bryce and Whitebread (2012) as well as Bryce, Whitebread and Szücs (2015) assume that monitoring and control activities are some of the few metacognitive abilities that are already developed at preschool age. Both processes, monitoring and control, are necessary for self-regulated learning (Winne & Hadwin, 2008) and play an important role in recording self-regulated learning competencies, too (Dinsmore et al., 2008). Studies revealed that metacognitive abilities in general develop with increasing age and this development takes place continuously (van der Stel & Veenman, 2014). Therefore, it seems feasible to foster young children's metacognitive abilities as a key aspect of self-regulated learning at an early stage (Winne & Hadwin, 2008). The present study picks up on this line of thought by conducting specific interventions and evaluations.

Metacognition and Self-Regulated Learning in the Early Years

Studies on metacognitive competencies and self-regulated learning are more likely to be found in primary and secondary school education sector (see i.e. Dignath & Büttner, 2008; Leidinger & Perels, 2012), despite evidence suggesting that self-regulated learning develops already in early childhood (Bronson, 2000). The age at which children first acquire metacognitive skills has been discussed matter of some discussion (Veenman & Spaans, 2005): some authors have pointed out that at least some components of control, monitoring and regulation processes of one's own cognitions are available at kindergarten age (see Bronson, 2000; Whitebread, 2012). Children at preschool age are able to adjust inexpedient behavior using initial metacognitive control strategies and can monitor their learning activities (e.g. Winne, 2018; Winne & Perry, 2000). Bronson (2000) also added that these children are capable of choosing tasks and goals corresponding to their cognitive abilities. At the age of five, they allocate attention to the actual task, which represent an important control strategy. Consequently, children at this age possess rudimentary metacognitive abilities such as control and monitoring activities (Bandura, 1997, Bronson, 2000). The existence of these basic competencies offers the opportunity to promote metacognitive activities at an early stage. In addition, such a promotion proves beneficial for academic performances (Blair & Razza, 2007; Diamond, 2016; Rimm-Kaufman, Gurby, Grimm, Nathason, & Brock, 2009). Moffitt and colleagues (2011) consider that an early improvement in these metacognitive skills and abilities leads to a better development and educational outcomes (see also Butler, 2004; Butler & Schnellert, 2012; Dunn, Rakes, & Rakes, 2014; Hidi & Ainly, 2008; Kitsantas, Steen, & Huie, 2017).

Improving Metacognition in Young Children

As outlined above, children at preschool age possess some rudimentary metacognitive abilities. They are able to recognize, plan, monitor, and control their cognitive processes (see Bronson, 2000; Özsoy et al., 2017; Whitebread, Anderson, Coltman, Page, Pino-Pasternak, & Metha, 2005). Therefore, studies that deal with the improvement of metacognitive competences seem conceivable. In fact, Hattie, Biggs, and Purdie (1996) assume that interventions with young children are effective since unfavorable learning habits have not yet been internalized and so it is easier to affect a good learning behavior. Nevertheless, most intervention studies in this area were conducted within the school sector (see Desoete, Roeyers, & de-Clercq, 2003; Labuhn, Zimmerman, & Hasselhorn, 2010; Perels et al., 2009). Comparable studies at the elementary level are rare (see Perels, Dignath, & Schmitz, 2009). Larkin (2010) highlights the transition from kindergarten to primary school as a sensitive phase in childhood because at this early stage children already develop their abilities and their attention on challenging tasks. In addition, Pramling (1990) determines that most metacognitive development takes place within this age range. Thus, it is favorable to make use of this crucial phase to promote preschoolers' awareness of their own learning processes. Fthenakis (2009) even mentions that it is beneficial to encourage children at preschool age in learning to cope with challenges or problem situations. That is, the appropriation of learning competencies is viewed as an important cornerstone of lifelong learning (Fthenakis, Gisbert, Griebel, Kunze, Niesel, & Wustmann, 2007; Lüftenegger et al., 2012). Thus, intervention research in the preschool sector has become increasingly important (see Adagideli e al., 2017; Whitebread, 2012).

With regard to possible metacognitive interventions at this age, there is a distinction between indirect and direct interventions (see Schmidt & Otto, 2010). Direct interventions address the learners themselves with the aim of optimizing learning behavior. Regarding direct interventions in general, there are a few successful studies (e.g. Glaser &

Brunstein, 2007; Landmann & Schmitz, 2007; Perels, Gürtler, & Schmitz, 2005), but there are practically no studies designed for the age of preschool children. Indirect interventions on the other hand focus on the environment of the learner (e.g. Pramling, 1990;1996; Souvignier & Mokhlesgerami, 2006; Whitebread et al., 2009). Usually, central caregivers such as parents or kindergarten teachers are involved in indirect interventions. Several studies have shown positive effects of some indirect interventions involving special programs for parents (Lund, Rheinberg, & Gladesch, 2001) or teachers (De Jager, Jansen, & Reezig, 2005; Souvignier & Mokhlesgerami, 2006). This kind of intervention aims at optimizing the learning environment in a way that optimal learning opportunities can be created (see Deci & Ryan, 2000). Within this context, special attention is to be attributed to observational learning/modelling. This term refers to adults' behavior (parents or kindergarten teachers) demonstrating positive examples of, e.g., certain learning behavior, which is subsequently imitated by children observing this behavior (Martinez-Pons, 2002). This kind of social learning is of considerable importance for early childhood development. Therefore, modelling or observational learning is taken into account in the reported study.

The present study combines both direct and indirect intervention to improve metacognition in preschoolers with the aim of paving the way to self-regulated learning: combined training with children, parents, and teachers (CPT), trainings with children and teachers (CT), training with children and parents (CP), training with children only (C), and a group without training (control group (CG). The important aspect here is that the preschool children are represented in each training condition, merely the contextual factors are changing.

Measuring Metacognition in Young Children

Only a few studies in the realm of metacognition have been concerned with the preschool sector (e.g., Whitebread et al., 2009). To evaluate intervention-induced improvements, it is necessary to establish measuring procedures for children under the age of six. Questionnaires or other well-established self-report methods cannot be used due to lack of literacy at this age (Whitebread et al., 2009). Therefore, preschool children require instruments in relation to their age, in particular nonverbal methods (Turner, 1995). Indeed, one possible alternative to self-reported methods are observations (see Whitebread et al., 2005). The advantage of observation methods is the collection of naturally occurring behavior in concrete learning settings regardless of language skills. For the present study, online measurements (Veenman, Prins, & Verheij, 2003) and standardized observations of preschool children were used while handling a problem-solving task (cf. train track task; Whitebread et al., 2009; Bryce & Whitebread, 2012). Thus, children's problem-solving behavior is examined by means of video recordings and an observation sheet, stemming from the Cambridgeshire Independent Learning project CINDLE (Whitebread et al., 2009).

Present Study

The current study deals with the effects of both direct and indirect trainings of metacognitive skills in the context of self-regulated learning. More precisely, we investigate the metacognitive monitoring and control strategies in young children at preschool age. The core research question is whether it is possible to improve metacognitive activities like monitoring and control activities in young children. Furthermore, the aim is to find out which training condition is more effective. We assume that the combination of the direct and indirect intervention will result in the highest increase of metacognitive competencies. Thus, the training condition with simultaneous training of children, teachers and parents (CTP) should result in the best outcomes concerning the metacognitive abilities and a childlike performance measure, since preschoolers who are consistently supported in their self-regulated learning in kindergarten and at home produce the best results. Furthermore, we investigated whether an improvement of metacognitive abilities leads to a performance improvement in a problem-solving task. Based on the assumption that, on the one hand, metacognition is a prerequisite for self-regulated learning behaviors (Boekaerts, 1999) and, on the other hand, that there is a positive correlation between self-regulated learning and performance (Butler, Schnellert, & Perry, 2017; De Corte, Mason, Depaepe, & Verschaffel, 2011; Hidi & Ainly, 2008), we assume that the interventions improve the results of a problem-solving train track task (Bryce & Whitebread, 2012), evaluated as a performance measure (see Blair & Razza, 2007).

Method

Participants

The study involved *N*= 137 children (45% female, Mage= 5.54 years, *SD*= 0.50) assigned to five groups: combined training with children, parents, and teachers (CPT, *n*= 20, 38% female, M_{age}= 5.12 years, *SD*= 0.33), trainings with children and teachers (CT, *n*= 21, 33% female, M_{age}= 5.60 years, *SD*= 0.50) or training with children and parents (CP, *n*= 9, 0% female, M_{age}= 5.67 years, *SD*= 0.58), training with children only (C, *n*= 51, 48% female, M_{age}= 5.60 years, *SD*= 0.50), and finally a group without training (control group (CG), *n*= 36, 67% female, M_{age}= 5.80 years, *SD*= 0.50). The aim was to random all participants into the five training conditions. The participants were recruited from 20 different kindergartens and daycare centers in Germany. All of them are in the last year of preschool, which is the preparatory year for primary school. Participation in the study was voluntary and required the parents' agreement. Testing and filming are only allowed when written consent is obtained. There are video data for each of the 137 children at two different points: before and after the intervention. The data was collected anonymously.

Intervention

The intervention consists of different training conditions: one direct training for the children, one training for the kindergarten teachers and one training for the parents. These three training conditions were combined systematically, resulting in the already mentioned five condition groups: combined training with children, parents, and teachers (CPT), trainings with children and teachers or parents (CP/CT), training with children only (C), and finally a group without training [control group (CG)].

The indirect intervention for the caregivers (teachers and parents) is characterized by a multi-level approach. On the first level, caregivers learned more about the metacognitive processes including strategies of metacognition in order to act as role model (see Martinez-Pons, 2002; Veniz & Perels, 2017), as described in the previous section. Caregivers serve as social models and they provide information on how to execute a task and how to engage in learning processes (Usher & Schunk, 2018). In addition, they had the opportunity to reflect on their own learning behavior concerning the three phases mentioned above, and if necessary to modify them. On the second level, kindergarten teachers and parents were introduced to strategies to support children's metacognitive competencies (Martinez-Pons, 2002). Whereas the training for parents focused on strategies in the home environment, the training for the kindergarten teachers pointed out some useful strategies for working in kindergarten. The training

took place in three sessions (one session per week), which were conducted separately for both groups. Each session lasted about one and a half hours and followed a common structure.

The direct intervention for the preschoolers was made up out of ten sessions, at two sessions per week, each lasting about 45 minutes. The training sessions included playful elements (for example stories, present plays, simple design tasks or problem-solving tasks) to make the content accessible to the children. The intervention did not focus on conveying the use of potential strategies in an abstract way, but rather on the application of the strategies in many multifaceted situations. This intensive training serves as education of the children according to the application of self-regulated learning processes including metacognitive strategies. The overarching concept of the training sessions was to reduce the number of trainer's instructions successively, so that ideally an autonomous use of strategies by preschoolers can be observed in the end. Children's' training sessions had a common structure, too, with a short greeting, a brief introduction of the new subject and strategy and the application of the strategy in a playful manner. So the preschoolers could practice or hone the respective strategy by means of short age-appropriate exercises with the guidance of the trainers.

Design

The study follows a repeated measures factorial design taking into account the described four experimental groups and a control group. First, the focus is on the report of the metacognitive activities monitoring and control, which are the dependent variables. For this, the observation data were acquired via a standardized observation sheet (see Whitebread et al., 2009). Data were collected before and after the interventions.

Measures

Metacognition. We use an observation method to assess metacognition that can be applied completely independently of language abilities. Preschoolers were filmed while solving a standardized problem-solving task, the train track task, drawn from the CINDLE project (see Whitebread et al., 2009).

The problem-solving task per se consists of the reconstruction of two geometric shapes (a closed circle (oval) and a form similar to the Greek Letter Omega (goggles)) by means of wooden railway tracks, adapted from Karmiloff-Smith's closed-circuit railway task (1979). The demonstrated problem-solving behavior while processing the train track task is coded by means of an observation sheet, which is dedicated to the recording of observable metacognitive behavior. This involves the categories monitoring (e.g., self-questioning, child highlights a problem to be solved, poses themselves a question: 'How will it curve around'; see Table 1), control (e.g., planning and explicitly stating a plan, which can be before or during the task: 'I´m going to do these straight bits first!'; see Table 1) and a third scale lack of monitoring and control (e.g., no strategy, when something will not work: 'uses same strategy over and over or gives up'; see Table 1). It follows the procedural metacognitive model by Nelson and Narens (1990).

The observation data were analyzed by two independent observers. Before the actual analysis took place, the observers completed an extensive training for the correct use of the observation categories. For this purpose, two observers coded 20 videos independently. Of special importance is a sufficient accordance between the t observers in terms of the above-mentioned categories (Gwet, 2014). High agreement indicates an accurate and reliable encoding of the observation data (reliability) and the dependability of the emitted judgments. For this reason, several meetings took place during which the application of the categories was practiced based on example videos. This process was repeated until a sufficient rater agreement was achieved and the observers found convergent solutions. Cohen's kappa served as a measure of rater agreement (Fleiss & Cohen, 1973). A sufficient agreement occurs if the values range is between .60 and .75; values greater than .75 are considered very good (Fleiss & Cohen, 1973). Ten sessions of rater conferences were necessary before a satisfying rater agreement could be found. In our study, we found an adequate agreement with $\kappa_{monitor}$= 0.83, $\kappa_{control}$= 0.66, and κ_{lackof}= 0.71.

Table 1. *Categories monitoring, control, and lack of monitoring and control of the encoding scheme*

Item	Example
	Monitoring
Checking own	Child pauses and looks at whole train track they have made so far.
Checking plan	Child glances back to the plan of train track they are working on.
Prospective monitoring	"This is going to be a challenge!"
Clarification	"Do I use all the pieces?"
Reviewing	Child glances around all the pieces of train track
Self-questioning	"How will I curve around?" (to self)
Commentary	"Right, this bit is done..."
Evaluation	"But that bit isn´t right!"
Justified termination	"Finished!"
	Control
Clearing space	Child clears the space on the table with hands before placing first piece down.
Planning	"I´m going to do these straight bits first!"
Sorting	Child compares the lengths of two straights.
Seeking	Child searches for all large curves.
Change strategy	Child reserves piece of track so that it curves in the correct way.
	Lack of Monitoring and Control
No strategy	Child tries to force two pieces of train track over and over and then gives up.
Not following plan	Child says they will start with straight edge, but then places a curved track piece.
Narrow view	Child looks for a straight piece but only looks in one area of the table.
Focus on join	Child is making a circle, but is so focused on making it join that he/she adds straight pieces.
Two positives	Child needs to add one more "junction-piece."
Large/small curves	In making a curved edge, child uses all small curves and has not realized, that he/she switched to large curves.
Finishing error	Child says that he/she has finished, when he/she has made a circle, not the goggle shape.
Goal neglect	"It´s because these ones don´t turn as well as those ones."

Train track task

The correctness of children's' solutions of the train track task is considered as a performance measure (Bryce & Whitebread, 2012; Whitebread et al., 2009). For both shapes, there were a total of nine items, which decipher important features of the track (e.g. for the oval shape: 'the track is jointed up', 'the track has one curved end', 'the track has another curved end', for the goggle shape: 'the track has one down/side bulge', 'the track has an inverted curve in center', 'the inverted curve is deep'), captured through a standardized category scheme (see Bryce & Whitebread, 2012; Whitebread et al., 2009). For each identified feature, one point can be received, so in total, 18 points are the maximum one can reach. The quality of the solutions of the train track task (Bryce & Whitebread, 2012; Whitebread et al., 2009) was determined by two independent raters. Similar to the evaluation of the observable problem-solving behavior, a sufficient accordance between the two raters was necessary, which required several rater meetings and exercises. The rater agreement was again calculated using Cohen's kappa. Due to an unequal marginal distribution of the ratings an adjusted Cohen's kappa κn is calculated (see Brennan & Prediger, 1981). The adjusted kappa value in this study was κn = 0.93; thus, the accordance accounts for 93%, which is a value that is regarded as good (Fleiss & Cohen, 1973).

Statistical Analyses

The effects of the interventions are tested via a 2 (time pretest/posttest) x 5 (intervention group) analysis of covariance (ANCOVA) with pretest values as covariates was conducted. An examination of the hypotheses was conducted using a univariate ANOVA with planned contrasts for the a priori comparison of the five training conditions. In particular, we assumed that (1) children under the training conditions (CPT; CT/CP, C) show better results than children in the control group (CG), that (2) these children show better results than the children under the single direct condition (C) and finally (3) that children under the combined condition CPT show better results than the children under the condition CT/CP. The effect sizes for the variance analyses were reported with partial eta squared (ηp2), and for the contrasts, Cohen's *d* was used (Cohen, 1969).

Results

Pre-analyses showed that the variables do not have a normal distribution. It is argued, that a violation of this condition becomes less important to the application of variance analytical methods in view of increasing sample size (Bortz, 2005; p. 286). It can be assumed that a variance analysis is robust when faced with this violation, in case with a rising number of participants, even in the face of unequal group sizes (ibid., p. 287). Therefore, we used a variance analytical method. No significant pretest differences were found regarding the scales monitoring ($F(3, 130)= .87$, $p= .46$) and lack of monitoring and control ($F(3, 130)=1.15$, $p= .33$). However, there was a difference between the training groups, referring to the scale control, ($F(3, 130)= 6.10$, p p= .00).

To further investigate the question of whether the implemented interventions lead to an improvement a one-way ANCOVA was conducted to determine a statistically significant difference between the five groups on monitoring, control, lack of monitoring and control and the performance measure, controlling for the respective pretest values. The results as well as the z-standardized means and standard deviations are displayed in Tables 2 and 3.

The (omnibus) evaluation of the data shows a significant interaction effect time × group for the scale control, $F(4, 131)= 2.55$, $p= .04$, $\eta_p^2= .07$. The interaction results from an increase in the means of the conditions CPT and CT with a simultaneous decrease in the means of the conditions CP, C and CG. Concerning the scale monitoring, no interaction effect could be found, $F(4, 131)= 1.96$, $p= .10$. Regarding the scale lack of monitoring and control, similar results were obtained, $F(4, 131)= .58$, $p= .67$. Table 3 illustrates the results of the evaluation referring to the performance data. No significant effect could be obtained.

Taking a closer look at the planned contrasts (see Table 4) corresponding to the hypothesis, the contrasts are formulated as follows. Contrast (1) expresses the superiority of all training conditions (CPT, CT/CP and C) over the condition without training (control group, CG). The combination of the direct and the two indirect interventions (CPT) is superior to the condition with the direct intervention and one indirect intervention (training with children and parents or with children and teachers CT and CP) (Contrast (2)). Contrast (3) evaluates whether condition with the direct intervention and one indirect intervention (CT/CP) is superior to the single direct condition (C).

For the scale control we found some significant contrasts. The planned contrast showed that all training conditions (CPT, CT/CP and C) are superior to the control group ($t_{(133)}= 3.20$, $p< .001$, $d= .67$). Furthermore, we found a superiority of the combined training condition (CPT) over the condition CT/CP ($t_{(133)}= 2.82$, $p< .001$, $d=.59$). Regarding the scales monitoring, lack of monitoring and control and performance, it is clear that no effect can be found. Based on these findings, it can be confirmed that – referring to the scale control – a combined intervention leads to better improvements than a single intervention condition.

Discussion

It is reasonable to ask why the intervention would not affect the monitoring activities or lead to a compensation in lack of monitoring and control. It could be a sign that young children are still limited in their metacognition, especially in monitoring their own cognition and learning behavior (Bryce, Whitebread, & Szücs, 2015; Freeman, Karayanidis, & Chalmers, 2017; Flavell, 1979). The procedural meta-memory is responsible for goal-oriented planning, monitoring, and control of one's own memory and learning activities (Mazzoni & Nelson, 2014). This ability increases with age. Further, Mazzoni and Nelson (2014) argued that if any problems are registered during the learning process, the learner must refer to adequate control processes. This could be demonstrated in our study: Children showed more control behavior while solving the problem-solving task after the intervention, but only in the combined condition CPT. In the opinion of Larkin (2010), control can only work if it receives information from the object-level, what, as we specified in a previous section, we know as the process of monitoring (see Nelson & Narens, 1990). That is, if any control activities were registered in this age group, monitoring activities must also theoretically exist. Pressley, Johnson, Symons, McGoldrick and Kurita (1989) stressed that the monitoring of memory processes takes place at a young age quite well (see also Mazzoni & Nelson, 2014). Thus, we only found an effect on the scale control, which is not an indication that no monitoring activities have transpired. Schneider and Lockl (2006) points out that a development of the procedural meta-memory is much harder to prove, in comparison to the declarative meta-memory which appears with less distinctive changes (Nelson, 1990). The development or improvement in procedural meta-memory is only due to the adequate use of control activities with increasing age.

Table 2. *Means (z-standardized), standard deviations and results of the interaction time x group (ANCOVA with pretest value as covariate) with the scales monitoring, control, and lack of monitoring and control*

AV		*M(SD)*				
	Group	Pre-test	Post-test	*df*	*F*	η_p^2
Monitoring	CPT	-0.26 (0.84)	0.19 (1.13)	4/131	1.96	0.06
	CT	-0.26 (1.06)	-0.56 (0.63)			
	CP	0.37 (1.17)	0.31 (0.67)			
	C	0.04 (1.03)	0.01 (1.09)			
	CG	0.15 (0.95)	0.13 (0.97)			
Control	CPT	0.73 (1.26)	0.83 (1.66)	4/131	2.55*	0.07
	CT	-0.05 (1.07)	0.11 (0.86)			
	CP	0.58 (0.92)	-0.04 (0.57)			
	C	0.00 (0.99)	-0.12 (0.80)			
	CG	-0.40 (0.56)	0.34 (0.65)			
Lack of monitoring and control	CPT	0.31 (0.76)	0.20 (1.04)	4/131	0.58	0.04
	CT	-0.34 (0.71)	-0.21 (0.94)			
	CP	0.51 (1.92)	-0.07 (1.15)			
	C	-0.14 (0.65)	-0.12 (0.92)			
	CG	0.09 (1.27)	0.18 (1.08)			

Note: CPT (Children/Parents/Teachers, *n*= 20), CT (Children/Teachers, *n*= 21), CP (Children/Parents, *n*= 9), C (Children, *n*= 51), CG (Control Group, *n*= 36), *p< .05

Table 3. *Means (z-standardized), standard deviations and results of the interaction time x group (ANCOVA with pretest value as covariate) with performance*

AV		*M(SD)*				
	Group	Pre-test	Post-test	*df*	*F*	η_p^2
Performance	CPT	-0.17 (1.08)	-0.00 (0.95)	4/131	0.85	0.04
	CT	0.32 (1.10)	0.19 (0.98)			
	CP	0.06 (0.87)	0.33 (0.71)			
	C	-0.24 (1.05)	-0.13 (1.07)			
	CG	0.23 (.77)	-0.01 (1.02)			

Note: CPT (Children/Parents/Teachers, *n*= 20), CT (Children/Teachers, *n*= 21), CP (Children/Parents, *n*= 9), C (Children, *n*= 51), CG (Control Group, *n*= 36), *p< 0.05.

A closer look at the instruments applied in this study and the three scales analyzed suggests that the difficulty to collect actual monitoring and control activities might lie in the scales themselves. The control activities (scale control) are operationalized with real observable behavior like clearing space, sorting, seeking, changing strategies, or gesturing. In contrast, the monitoring scale is operationalized with more verbal abilities like checking plan, prospective monitoring, self-questioning, or less observable behavior like reviewing or error detection. Thus, it is also possible that the children, for example, highlight a problem to be solved and pose themselves a question, or judge the task before task begins, but this can happen in the form of 'inner speech" (see Alarcón-Rubio, Sánchez-Medina, & Prieto-García, 2014; Diaz & Berk, 2014; Vygotsky, 1978). Ultimately, control activities are better or easier to encode by the observer than monitoring activities, for the simple reason that control activities are more easily observed than monitoring activities.

However, the question arises why we did not find any results regarding the performance measures. It could be

Table 4. *Results of the a priori defined contrasts*

AV					
	Contrast	Contrast value (*SD*) Posttest	*df*	*t*	*d*
monitoring	1	-0.42 (0.51)	133	-0.82	-0.17
	2	0.42 (0.23)	133	1.71	0.52
	3	-0.27 (0.20)	133	-1.35	-0.33
control	1	2.50 0(.78)	133	3.20**	0.67
	2	1.07 (0.38)	133	2.82**	0.59
	3	0.26 (0.30)	133	0.87	0.24
lack of monitoring and control	1	-0.16 (0.15)	133	-1.04	-0.22
	2	0.10 (0.08)	133	1.28	0.34
	3	-0.02 (0.06)	133	-0.27	-0.04
performance	1	0.03 (0.12)	133	0.23	0.05
	2	-0.05 (0.06)	133	-0.81	-0.26
	3	0.07 (0.05)	133	1.55	0.39

Note: # $p < .10$, *$p < .05$, **$p < .01$

that such an effect does not appear in general or if our performance recording procedure is inadequate. The preschool age entails a challenge concerning the application of performance measures. Common instruments, which collect cognitive abilities such as mathematic or literacy abilities, cannot be used because these skills are not yet developed at this age (Blair & Razza, 2007). This age group requires a more generic measure, independent of previous knowledge. It can be questioned whether the handling of the wooden railway tracks is an appropriate measure, but so far no alternative procedures exist for this age group. Moreover, the train track task was successfully used in other studies involving young children (e.g. Whitebread et al., 2005). Bryce and Whitebread (2012) stated that the problem-solving train track task is suitable to represent metacognitive abilities in young children as accurately as possible. They argued it is a 'novel challenge with familiar materials" (Bryce & Whitebread, 2012, p. 214); however, there is no evidence for the familiarity of the wooden railway tracks used in the task. It is therefore conceivable that some participating children may not have had previous experience with railway tracks. In this case it is a 'challenge with familiar materials' by no means. Apart from that, it could be a gender-specific problem and boys have much more practical experiences with wooden railways tracks than most girls. Therefore, it may be appropriate that experiences in dealing with the used materials must be collected in further studies. However, no gender difference could be found in the present study. Further studies might want to focus on the development of a performance measure for preschool age children that can be used in a generic manner.

We can find some limitation in the methodical implementation. It was not possible to realize a randomized assignment of the preschoolers to the different training conditions. The interest of the kindergarten management in the direct intervention with the preschoolers was high. The participation of the kindergarten teachers or parents themselves depended on time-related and organizational factors. Many institutions were understaffed or had a full schedule, so that the intervention with teachers was often not conceivable. In addition, a lot of institutions have had some bad experiences with parent's willingness to participate in enrichment offers like the one made for this study. In fact, it was difficult to find enough parents for a realization of the interventions. From the very beginning of the study most of the kindergarten institutions already signed up for a certain condition, making randomizing almost impossible. Under these circumstances, it was quite difficult to gain enough participants for each intervention condition. Precisely since it was difficult to fill the conditions that take parents into account, the intended sample sizes for some conditions weren't fulfilled. This issue lead also to the fact that the sample sizes of the training condition groups differ (Keppel & Wickens, 1991). Therefore, children's pretest values were controlled.

However, the problem may also lie in the field of data acquisition. The used observation sheet pursues the claim of a collection of naturally occurring behavior in standardized learning settings. This also includes the collection of verbal and nonverbal behavior. However, the sheet cannot collect the 'inner speech," which is often used in this age range (Alarcón-Rubio et al., 2014; Diaz & Berk, 2014; Vygotsky, 1978). As described above, important abilities such as those contained in the scale monitoring cannot be recognized. Consequently, metacognitive activities cannot be measured completely by means of observation methods. It is conceivable to encourage children to speak about their thoughts in terms of 'think-aloud protocols" (Greene, Deekens, Copeland, & Yu, 2018; Veenman, VanHout-Wolters, & Afflersbach, 2006). Observation data may therefore be complemented with these protocols. With such a multi-method approach (see also Desoete, 2008), it may be easier to get a comprehensive picture of the observable and non-observable metacognitive abilities and the actual use of monitoring and control strategies. Furthermore, future studies could try to adapt the observation sheet for the assessment of young children's metacognitive abilities. Therefore, the focus of further studies must be placed on the assessment of monitoring activities, or rather in the adaptation of the assessment instrument in the sense that an acquisition of monitoring activities is easier to carry out. It is therefore conceivable that in further research another 'online observation" could take place (Veenman, 2013). Independent observers could monitor kindergarten teachers while working with the preschoolers; it is also important to ensure whether the support strategies are implemented and whether there are some differences in the use of monitoring and control strategies. Such observations would be quite difficult to implement in the home environment. However, in today's kindergartens, observations are a daily business. Apart from the limitations in measurement, additional limitations in the intervention must be reported. Clear and standardized instructions were given to all participants. Nevertheless, it was not validated whether and in what manner parents and kindergarten teachers implemented the learned strategies. Both samples, parents and teach-

ers, stated in a survey that they were aware of more support strategies after the intervention. However, an actual use of these strategies in dealing with the preschoolers was not checked.

Conclusion

Overall, the results of the study are generally sobering. What we could demonstrate was an early improvement in some of the metacognitive skills assessed, namely control activities as a crucial prerequisite for self-regulated learning. Based on the dataset analyzed here this would imply that preschoolers possess some metacognitive abilities (Larkin, 2010). Thus, an improvement of this ability seems possible already in this age range (Bronson, 2000; Bryce & Whitebread, 2012), laying the foundation for young children to become self-regulated learners one day. Moreover, the involvement of caregivers – parents and kindergarten teachers – proved to be useful. Parents as well as kindergarten teachers learned more about children's ability to apply metacognitive skills in the early years, and they got to know helpful strategies to support the children in their use of these abilities. For the reported age group, a large number of suitable instruments does not yet exist and most of the familiar instruments are used in this study. Thus it becomes apparent that these instruments have some weaknesses and therefore cautious adaptation is recommended when using these instruments. Generally, in forthcoming studies an emphasis should be placed upon the development of age-appropriate instruments to evaluate metacognitive abilities and self-regulated learning in young children. In addition, more analyses must be undertaken to make additional assertions referring to gender differences or age effects (Perry et al., 2018). It may also be of interest to determine whether the metacognitive abilities are correlated with intelligence.

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Changing in Mathematical Identity of Elementary School Students Through Group Learning Activities

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Abstract

This article aims to describe the mathematical identity of elementary school students during studying mathematics. When studying mathematics, the students often face difficulties in understanding the concepts which results the decrease in their learning motivation. It will lead to the lack of development of their mathematical identity. The students who are able to develop their mathematical identity well are more likely to succeed in learning mathematics. A qualitative approach was employed to trace the students' mathematical identity. Questions and interviews were used to collect the data. The findings indicated during participating in the group learning activities, the students were able to increase their motivation. Therefore, it can improve their mathematical identity.

Keywords: Group Learning, Identity Change, Mathematical Identity, Motivation

Introduction

Several studies concluded that elementary school students consider mathematics only as an arithmetic operation (Abbasi, 2016). This assumption decreases the mathematics learning outcome of the elementary school students, they do not deeply comprehend the concept of mathematics, eventually, they also lack ability to solve the problem. One of the students' poor problem-solving abilities is the understanding concept of geometry.

Geometry is one of the study subjects that has many concepts. From a psychological perspective, geometry is the presentation of abstraction from visual and special experiences, for example, fields, patterns of measurement, and mapping. Whereas from a mathematical perspective, geometry provides approaches to problem-solving such as pictures, diagrams, coordinate systems, vectors, and transformations.

The purpose of geometry learning is gaining the students' confidence in their mathematical identity abilities, having good problem-solving abilities, and able to communicate mathematically and rationalize well (Bobango, 1993). Basically, geometry has a greater opportunity to be understood by the students because its ideas have been widely known by the students even prior to entering formal education. These ideas are lines, fields, and spaces. However, the facts show that students' learning outcome of geometry are still low and need improvement (Bobango, 1993). Even in Indonesia, among various branches of mathematics, geometry is the most concerning subject which has low learning outcomes (Sudarman, 2000). To the present day, the results of this study are still valid in one of the elementary schools in Indonesia, precisely in East Java.

The difficulty of students in understanding the concept of geometry is caused by their inability to receive the abstract concepts in mathematics. Since elementary school students are very young, they do not have the ability to learn mathematical concepts that are mostly abstract (Del Fava, 2005). This inability decreases the students' learning motivation. Whereas, motivation has been proven to improve conceptual understanding and improve learning outcomes (Grolnick & Ryan, 1987). Motivation also affects the formation of students' mathematical identities because motivation is one of the factors that build mathematical identity (Martin, 2000). Then, the students' mathematical identity will be poor if their motivation is low (Crompton, Ford & Grant, 2015).

Mathematical identity is like a construct that describes a person's relationship with mathematics. The students' mathematical identities are formed along with the learning at school. Students learn to understand themselves as students of mathematics through their experiences in math classes; interaction with teachers, parents, and peers; which are related to the future that they will face (Radovic et al., 2017). By knowing the mathematical identity of students, researchers expect to get a better understanding of the relationships that are built between students and mathematics. We utilized the established relationship between students and mathematics as an effort to identify the causes of the difficulties and the decrease in students' motivation in learning mathematics.

Identity research is not only used in the field of psychology but also in the field of education because identity theory is used to help explain the development of mathematics learning in the classroom (Juzwik, 2006; Sfard & Prusak, 2005; Wenger, 1998). The identity revealed in this research was the students' mathematical identity. In general, mathematical identity is expected to be one of the ways to capture students' learning experiences both personally and in groups. The students' mathematical identities described as narratives related to learning experiences, motivation, strategies and other things related to mathematics and student relations. Therefore, the purpose of this research was to reveal the mathematical identity that elementary school students built when learning geometry and examining the mathematical identity that elementary school students built when they were studying in groups. In addition to tracing students' mathematical identities, this study also examined the possibility of changing mathematical identities raised by students when they were studying with their peers. This change is

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expected to be one indicator of the increase in students' motivation and understanding of concepts; of course, it is expected to be able to improve the quality of learning mathematics.

Theoretical Framework

Mathematical identity

Identity is related to how someone defines themselves and how others define that person (Martin, 2009; Oppland-Cordell & Martin, 2015; Sfard & Prusak, 2005a). Therefore, a person's identity may include someone's experience and involvement with others. When associated with students, experience, and involvement which shape the identity, they are the experience and involvement of students while participating in the classroom learning activities. In this study, the experience of involvement was limited to the experience and involvement of students in the mathematics class. One of the factors of forming the students' experience comes from their involvement while learning mathematics with teachers and peers. When the students went through the learning experiences that was when their identity was formed.

The description of the learning experience of mathematics is called a mathematical identity. More precisely, there was a research which refers to the definition of mathematical identity presented by Martin (2009)

> *Mathematics identity refers to the dispositions and deeply held beliefs that individuals develop about their ability to participate and perform effectively in mathematical contexts and to use mathematics to change the conditions of their lives. A mathematics identity encompasses a person's self-understanding and how others see him or her in the context of doing mathematics. (pp. 136–137)*

The nature of identity can be categorized as dynamic and sustainable based on one's life experience when dealing with others (Wenger, 1998). While the mathematical identity is unstable, has many changing, constructive, multi-contextual, relational, and emotional natures (Kaasila & Lutovac, 2011).

The dynamic nature of identity allows students to experience changing in mathematical identity. This changing is influenced by many factors. In this study, changes in identity traced through group learning activities, because group learning could improve students' understanding and motivation while learning mathematics (Darinka Radovic, 2017). Therefore, the group learning affected the mathematical identity of the students due to a good understanding of the concept, eventually the students could develop a better mathematical identity (Rosemary Mkhize, 2017).

Besides having several properties, mathematical identity has several components underlying the formation of mathematical identity. The components of mathematical identity delivered by Martin (2000) were the information about (a) the importance of mathematics for someone, (b) motivation to learn mathematics, (c) learning opportunities for mathematics, (d) strategies for learning or participating in the context of formal and informal mathematics, (e) obstacles faced in learning mathematics, and (f) capacity or ability possessed to participate in mathematics learning. Based on the six components, the researchers limit each component so that the description of the mathematical identity that was built did not expand. This limit would be an indicator of mathematical identity used as a reference by the researchers. The development of this indicator is presented in Table 1 and referred to the description as presented by Larnell (2016, p.240).

Identity narrative

Mathematical identity is expressed through narrative (Sfard & Prusak, 2005b). The narrative that described by researchers here was in the form of a person's story while studying mathematics, encompassing past related mathematics, conceptual and pedagogical abilities of mathematics, experience, relationships with others, and students' expectations after learning mathematics. In other words, students' identity narratives are defined as one way of telling themselves or others about themselves as students (Kaasila, Laine, & Pehkonen, 2005). This identity narrative could later be seen as a product of a reflective process because it has been changing over time in the learning process. Narrative changing were triggered by the context of problems, situations, and social relationships (Hannula, 2016). Narratives about identity were expected to be able to answer the question "who you are" in a situation or condition (Juzwik, 2006).

Research Method

This study employed a qualitative approach. The research design included five stages. First is problem identification. This identification had been included in the background. Second and third are collecting and interpreting data. Fourth, intervention or action based on initial data. Interventions in the form of group learning activities could be done by students to solve problems in mathematics and efforts to increase the development of identity. Group learning activities were chosen because the relationships with peers are activities that could be used to develop themselves and students' self-confidence (Marsh, Trautwein, Ludtke & Koller, 2008). Group learning influenced the value and meaning of mathematics learning in students (Francis, Read & Skelton, 2010). Fifth, evaluation and reflection of the results.

Figure 1 below presents the research design chart employed by the researchers:

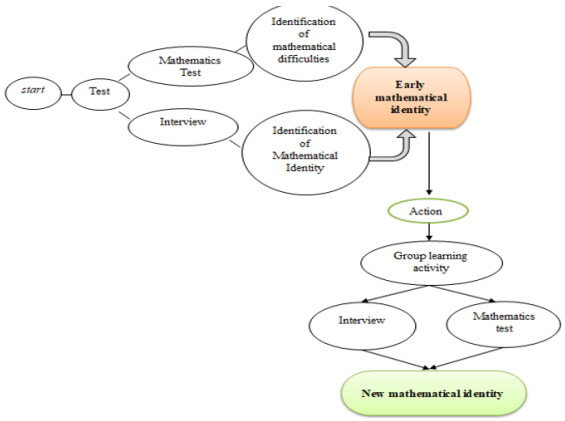

Figure1. Research design

Data collection

To gain knowledge about class conditions and foster students' trust, we visited classes to observe, talk (approach, explore information) with students during break time and participated in math lessons. Table 2 reveals the summary of actions taken to trace students' mathematical identities during self-study and the changes that arise in students' mathematical identities during the group-learning activities.

In the next step after data collection, we made graphic representation of the mathematical identity of the student. The purpose of making this graph was to find out the changes in mathematical identity that occur in students. This changing would show the mathematical identity that

Table 1. *Indicator of Mathematical Identity*

Factor	Description	Indicator	Scale	Information (Example of Statement)
The important of mathematics	About the meaning of mathematic for students, whether it is as a useful effort or mathematics as a scientific discipline (now or later)	Mathematics has no meaning in one's life	1	"I prefer natural science to math"
		Mathematics means as a science that must be taken	2	"yes you have to study math, it is compulsory"
		Mathematics means as knowledge that is useful for everyday life	3	"if we don't study math, then we can't count. If we buy something, we don't know the change "
Motivation	About reasons to be involved in in math activities	Take math class only as the duty	1	"the important thing is listening to the teacher"
		Complete math assignment only because it is assigned by the teacher	2	"it's ok if the one who do the task is my tutor not me, as long as I submit it to the teacher."
		Motivated to prove ability and to be able to compete with peers	3	"I have to get better score than my classmate"
Strategy	About tactics or preferred methods for completing mathematical work	Avoid math	1	"I hope the teacher do not appoint me" (head down)
		Trying to follow the math course	2	"just keep silent, don't talk too much"
		Actively engage during the math course	3	"I like to answer when the teacher asks questions" "I will ask if I don't understand yet."
Opportunity	About the opportunity to participate in the context of mathematics or acquire mathematical knowledge	Learning environment does not support mathematics learning	1	"My school is located near a field, so it's very noisy, I couldn't study well"
		The learning environment strongly supports the process of learning mathematics	2	"my parents want me to get extra tutoring lesson"
		Get support from the learning environment and be able to explore the support so that it's emerging the new knowledge	3	"additional tutoring get me understanding mathematics more "
Obstacles	About the obstacles faced when participating in the context of mathematics	Recognizing the obstacles in learning, but there is no effort to overcome them	1	"It's better to cheat on friends if there is an assignment because usually it is very difficult"
		Realizing that there are some obstacles, but rely on the teacher to overcome these obstacles	2	"if there is a test on whiteboard, it is better to wait until a friend is going to do it first or the teacher explains.."
		Realizing that there are some obstacles, and try to actively explore information and take actions that can be used to overcome these obstacles	3	"make a note on the questions that I have worked on before" "Practices many times at home so that I could do the questions given by the teacher later on."
Capacity to do	About what is known already, a person's ability to take advantage of learning opportunities	Passive in math class	1	"What to ask? I don't understand what to ask"
		Encouraged to try harder in learning math	2	"I also want to be able to do math, just like my friends"
		Other friends also encourage to do better	3	"my friends like to discuss math problem"

Note: Scale 1, 2, 3 show the level of each component based on the student's statement during the interview.

students have developed in a more positive direction. Figure 2 depicts a guide to make a graphic representation of students' mathematical identities.

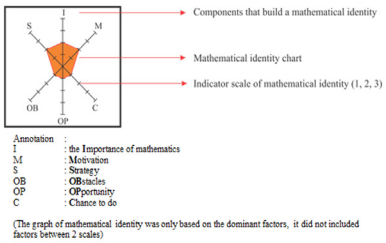

Figure 2. Graphical representation of mathematical identity

Making a graph of mathematical identity was done by: (1) Identifying students' opinions about mathematics learning in accordance with the results of interviews, (2) Students' opinions were sorted and adjusted to the indicators that have been determined by the researcher, (3) Determining the scale that represents the opinions of students and the last (4) Drawing on the fields provided.

This graphic representation was presented for each research subject because each person's mathematical identity was different. The presentation of graphical representations was raised at each stage of the research. This was done so that the changes that appear could be seen clearly at each stage of the research.

Participants

The subjects in this study were fifth-grade students from three different elementary schools. The selection of elementary schools was based on the lowest mathematics scores obtained for three consecutive years. This was because schools were identity-forming agents, so schools that had a low reputation for mathematical values resulting in low students' mathematical identities (Rosemary Mkhize, 2017).

Table 2. *Data Collection*

Stage	Description	Instrument	Purpose	Research Data	Results
I	Identifying problems experienced by students (early identification of mathematical identity)	Mathematics test (geometry, algebra, arithmetic, etc.)	Reading on the part where the subject had difficulty in learning mathematics	Students' work results Results of interviewing mathematical difficulties	Students have difficulty understanding the concept of a circle
II	Students were asked to work on geometry problems without help from friends	Geometry test Interview	Reading students' initial mathematical identities	Students' work results Mathematical identity interview results	Students' mathematical identity (initial identity)
III	Asked students to do group learning activities. this activity was used to overcome students' problems	Geometry test Interview	Reading students' mathematical identities while learning in groups	Students' work results Mathematical identity interview results	Students understand the concept of circles Students have a new mathematical identity
IV	Gave similar questions about circles to ensure students' understanding of the concept of a circle	Geometry test Interview	Reading the changing and consistency of mathematical identity	Students' work results Mathematical identity interview results	Students understand the concept of circles Searching for consistency of new mathematical identities

Furthermore, the fifth-grade students were designated as research subjects, because students at the fifth grade were able to reason and think abstractly. Students at this level had obtained sufficient concept knowledge during elementary school, especially since fifth-grade students begin their study for the national exam. Poor understanding and motivation would affect the readiness of students to take national exams. From each school, there was one student chosen as the subject of this research. The student had a history of difficulties in understanding mathematical concepts. This history was supported by data from test results that had been given to students. The three students were obtained as subjects, namely Celsi, Lala and Galuh (pseudonyms).

Results

The first stage

The results in the first stage were the identification of mathematical problems experienced by students. At this stage, researchers had given questions to students to identify where the students have learning difficulties. Next, we identity students' mathematical identities by using interviews. The conclusion of the first stage of identification is explained in Table 3.

Based on the below results, we built the initial assumptions that were used as the basis for identifying students' initial mathematical identities. This assumption was a mathematical identity built by students is less developed because students experienced a failure when trying to solve mathematical problems. These experiences led to negative attitudes and decreased their motivation to learn about mathematics.

At this stage, two students showed a high confidence while learning mathematics. The confidence shown relates to the desire to compete between Celsi and Lala. Unlike the two students, the third student (Galuh) seemed to be less enthusiastic. The questions given in the first stage included arithmetic, algebra, and geometry (according to the curriculum that applies in the third school of students). We did not contribute any intervention in order to identify students' learning difficulties and their initial mathematical identity.

Table 3. *Identification of Learning Difficulties and First Stage Mathematical Identity*

1	Data on students' work results	Students had difficulty understanding geometry, especially about circles The term "diagonal" appeared when studying the concept of circles Resolving a circle problem was only based on the number that "appears" in the problem, not trying to understand the problem to be solved
2	Data on mathematical identity interviews	Students were less motivated Students were lazy to learn mathematics Family background supports student learning progress Students considered mathematics to be a "counting lesson" Students had a negative attitude because they had failed in solving math problems

The second stage

In the second stage, we used the identification of problems that had appeared in the first stage. One of the identifications was students had difficulties in understanding the concept of a circle. The difficulty in understanding concepts makes the mathematical identity to be less developed shown by students (Rosemary Mkhize, 2017).

At this stage, we gave several questions that were only related to the concept of a circle. After that, we conducted a mathematical identity interview. This interview was conducted after we examined the results of students' mathematics tests. The following Table 4 describes the identification of students' mathematical identities based on the results of interviews that had been sorted according to mathematical identity indicators.

Furthermore, the findings above were represented using a diagram. This representation referred to the results of interviews that were adjusted to the indicators which had been determined in theoretical studies. Figure 3 shows the graphic representation of mathematical identity on the second stage.

Table 4. *Second Stage Mathematical Identity Identification*

Name	Components of Mathematical Identity	Interview Result	Scale
Celsi	The importance of mathematics	"Mathematics= number and formula" "Mathematics= counting" Love math because mathematics is a lesson that has many numbers, it's simpler than having to write a story or playing with words	2
	Motivation	"I like to get good grades on math"	3
	Strategy	"My friend always answers the questions from teacher, meanwhile, I rarely do that." (I answer only if the teacher asks me)	2
	Opportunity	Celsi's parents said, "she (Celsi) refused to get additional tutoring, because studying alone at home was enough"	2
	Obstacle	"I can't do circle problems, I will just wait for friends to come forward "(waiting for friends to work first)	2
	Opportunity to do	"I like to make notes for myself, to study at home and ask material which I have not been mastered yet to friends ."	2
Lala	The importance of mathematics	"The lesson is boring."	1
	Motivation	"If I have additional tutoring, I usually works on my assignment too. So I let my tutor help me."	2
	Strategy	"I don't like to ask"	2
	Opportunity	"I was told by my mother to take additional math tutoring."	2
	Obstacle	"Understand the diameter of the circle as "diagonal"." "If I forget to do my homework with my tutor, and I couldn't do it alone, I usually copy my friends' work."	1
	Opportunity to do	"I use the "practical formula" that I got at the tutoring to work on the questions given by the teacher in the classroom."	2
Galuh	The importance of mathematics	"I like natural science than mathematic."	1
	Motivation	"I rarely "speak" in math class."	1
	Strategy	(On the mathematics problem that she couldn't solve, she directly wrote "I can't do it, Mam" or "give up") by saying " I can't, Maaaaam..." without trying to do it first.	1
	Opportunity	"Hopefully, the teacher doesn't appointed me to do the task." (head down)	1
	Obstacle	"My school is located near a field, so it's very noisy. I couldn't concentrate to study well." (depends on the gadget to solve math problem)	1
	Opportunity to do	"I called a private tutor to teach me at home."	2

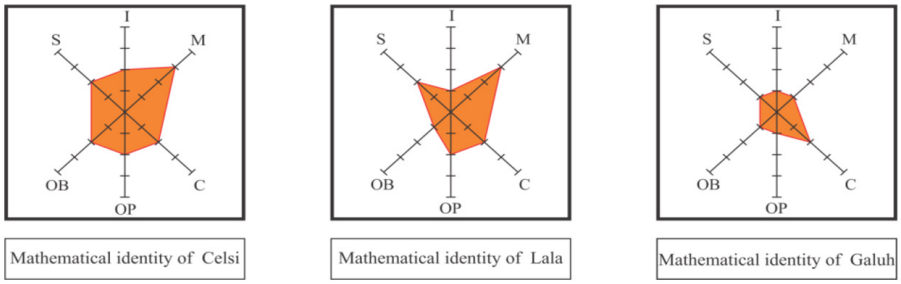

Figure 3. Students' Mathematical Identity When Learning Independently

The Third Stage

In the third stage, we gave limited intervention in the form of direction to overcome learning difficulties with group learning. We had given a "clue" so that students could be led to problem-solving. One of the "clues" given by researchers was asking students to look for real examples of circular objects around them. After getting the object, we asked the students to identify the location of the center point, radius, and diameter.

Initially, the three students had difficulty in finding the locations of the center point, radius, and diameter. For this reason, the researcher gave a little information regarding the understanding of the center point, radius, and diameter. Based on this information, all three students looked for the locations in question. As a result, the three students managed to find the location of the center point, radius, and diameter. The next step after successfully identifying the center point, radius, and diameter, the students were asked to understand how to find the area and circumference of the circle. Students managed to search broadly and around the circle based on information they had understood.

The experiments in group learning activities made the students begin to like mathematics. This was because mathematics was learned by using objects that are around them.

Table 5. *Identification of The Third Stage of Mathematical Identity (Group Learning)*

Name	Components of Mathematical Identity	Interview Result	Scale
Celsi	The importance of mathematics	If there's example (with object around them) I think it will be easier to learn math	3
	Motivation	If there is a math test, I think my grade would be higher than them (the others two students, Lala and Galuh)	3
	Strategy	I think, I will not be ashamed to ask if I don't understand. Because I know a little more than yesterday (last week)	3
	Opportunity	Studying in groups with them (Lala and Galuh) is fun, although Galuh is a bit annoying The three of us did not understand circle material, but group learning made me understand	3
	Obstacle	The three of us did not understand circle material, but group learning made me understand	3
	Opportunity to do	I summarize the group learning results so that it is easy to learn They don't seem to do it (summarize) (take a note of important things needed for independent learning)	2
Lala	The importance of mathematics	I like math a little more I realize that math (circle representation) could be useful for anything other than selling and buying thing	3
	Motivation	Not bad, if there is a circle problem, I think I can do it	3
	Strategy	Even though I don't understand, I still don't dare to ask if I don't understand, I'm afraid.	2
	Opportunity	It seems, besides tutoring I can understand mathematics by learning in groups	2
	Obstacle	I just found out that the circle doesn't have a diagonal (with a smile) Group learning made me understand that.	3
	Opportunity to do	My friends aren't used to learning together like this even though it's fun.	2
Galuh	The importance of mathematics	Math is fun too.	2
	Motivation	It's good if you study in groups like this, you can do the questions together	2
	Strategy	I'd better if I asked a friend if I don't understand (Researchers asked Galuh to reduce gadget usage)	2
	Opportunity	Later when I was studying at home, I would study group with my tutor	2
	Obstacle	Usually I am embarrassed, but I will try not to be ashamed to ask if I can't	3
	Opportunity to do	(During the discussion, Galuh dared to express her opinion, even just a little) I think ...	2

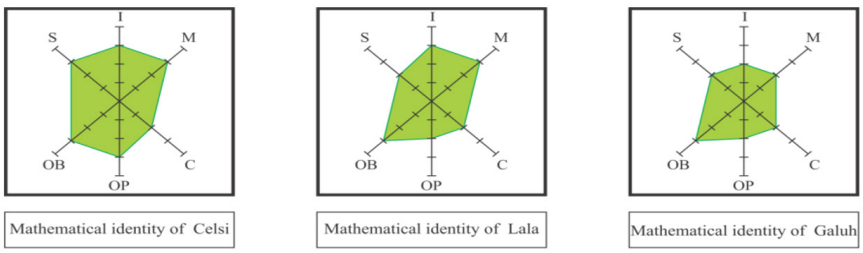

Figure 4. Students' Mathematical Identity When Learning in A Group

In this third stage, the mathematical identity of the three students was developed into a positive identity. These three students' perception towards mathematics had changed when they knew that in mathematics there were not only numbers and formulas. Students started to like mathematics when they understood that something abstract could be represented through examples of objects around them. Table 5 explains the mathematical identity of students in the third stage:

Based on the results of the interview, a graphical representation of the three mathematical identities of the students when learning groups is shown in Figure 4 above.

The Fourth Stage

The fourth stage was the final stage in researching this mathematical identity. At this stage, we examined the consistency of the new mathematical identity built by students. At this stage, the three students had an agreement and understanding related to the circle material they had discussed during group learning. Therefore, we also asked the students to make problems accompanied by answering the test related to the concept of circles to measure their level of understanding. The results showed that the three mathematical identities of students tended to be the same as the mathematical identities that were built in the third stage.

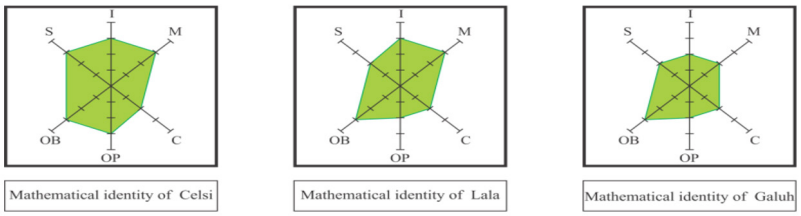

Figure 5. The Consistency of New Mathematical Identity

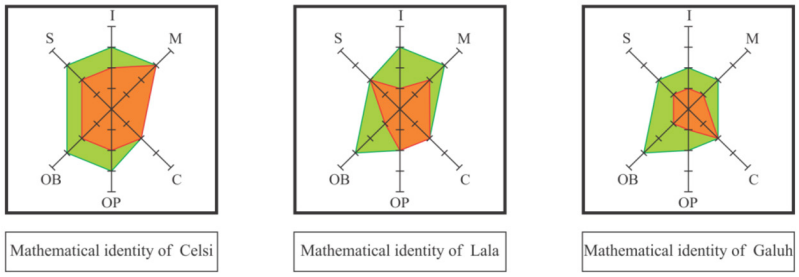

Figure 6. Changing From The Initial Identity (Independent Learning) to The New Identity (Group Learning)

Table 6. *The Changing in Students' Mathematical Identity*

Name	Mathematical Identity
Celsi	Celsi's new mathematical identity showed the development of motivation and strategies used to actively participate in mathematics learning. This made Celsi realized the meaning of mathematics more deeply, not just subjects that she must learn. Celsi was getting better at utilizing opportunities provided by the surrounding environment to explore mathematical abilities to minimize learning barriers experienced. There was one less developed factor, it was the lack of opportunities for Celsi to play an active role with friends in learning mathematics.
Lala	The new mathematical identity shown by Lala was an increasing in motivation. Lala was increasingly aware of the importance of learning mathematics, not just limited to buying and selling activities. The obstacles faced by Lala was gradually diminished, dued to high learning motivation and support from around. Lala had not experienced development in the aspects of strategy and opportunities because Lala chose n to not take the initiative too much to develop strategies to take advantage of opportunities in learning mathematics.
Galuh	The new mathematical identity shown by Galuh was a fairly good development in terms of solving the obstacles experienced while studying. In addition to the ability to solve obstacles, Galuh experienced quite good development in all aspects of mathematical identity. This development was strongly supported by researchers, considering Galuh was a subject who was very dependent on "gadgets". The development of Galuh's mathematical identity was an achievement that was expected to be further developed in the future.

Figure 5 shows the graphical representations of the consistency of students' mathematical identities in the fourth stage:

The Changes in Students' Mathematical Identity

The changes in students' mathematical identities arisen from the initial identities are shown by students when participating in learning activities in the first and second stages into a new identity when students learned in groups in the third stage. The mathematical identity shown by students changed as they participate in group learning to solve the difficulties of understanding the concept of the circle they were facing. In addition to group learning, students also used the objects around them to understand the concept of a circle that cannot be understood. The consistency of students' mathematical identities in the third stage was traced to the fourth stage.

Knowing the existence of change could be a discourse for the teacher to be able to see the "other side" of how students view mathematics. Various opinions were a good reference when determining a student's mathematical identity. By knowing the mathematical identity of students, a teacher or parent was expected to pay more attention to the development of learning that students have taken. Figure 6 shows the graphical representation of changes in mathematical identity shown by students during self-study and group learning:

Based on the graphical representations, it was clearly visible that there were changes in students' mathematical identities. This change was perceived to be a development of a mathematical identity that led to a better direction. Table 6 above briefly describes the changes in the mathematical identity of the three students:

Discussion

In each component, there were similarities in identity shown by Celsi, Lala and Galuh. In the first component of mathematical identity, all three students assumed that the role of mathematics in everyday life was limited to arithmetic and calculation. This was proven when the three were asked to give examples of the use of mathematics in their daily lives, all three of them gave solid examples of the processes of buying and selling.

Students' views on mathematics related to difficulties when understanding the concept of circles in mathematics learning revealed a less developed identity. This was shown by some students' opinions, such as "mathematics is difficult", "mathematics is only = numbers + formulas" and "I like math only if I was told to count" reflected a less developed mathematical identity when students learned mathematics. This certainly affected the performance of students in learning mathematics, resulting in decreasing of learning motivation, and low learning outcomes.

However, it was different when the students were given the opportunity to learn and understand mathematics by doing group learning. The description given by students was different from the initial description they built about mathematics, for example, "it is nice to learn mathematics like this", "It is easier for me to remember the material circle", "if it is exemplified like this, and it is easier to under-

stand". All narratives conveyed by students created new mathematical identities that reflected beliefs that were contrary to dominant beliefs which stated that "mathematics is difficult".

Learning in groups had succeeded in creating new mathematical identities and forming positive student identities. This could be seen from their expressions of interest when learning the concept of circles. Confusion and difficulties at the beginning of learning were not visible. Now students could confidently deal with the questions given to them. Group learning created effective mathematics learning, such as increasing problem-solving which is the core of mathematics learning (Francis, B., Read B & Skelton, C., 2010). But more importantly, it increased the students' motivation to learn mathematics. This was expected to affect the development of mathematical identity in a better direction.

Findings

Based on the four stages that students have passed, we found a mathematical identity that was inherent with the three students. This mathematical identity was obtained by researchers when students learned by themselves or when students learned groups. The following was a narrative of the three students' mathematical identities:

Celsi "self-confident"

From the first stage, Celsi had shown that she had no difficulty in learning mathematics at all. This attitude was reinforced by his parents' statement which stated that Celsi had never complained about mathematics to parents. This attitude was shown by achievements or good results related to the grade obtained by Celsi in mathematics. In group learning activities, Celsi did not hesitate to give opinions. Helping other friends to solve the problems was also done. Celsi was a student who has a good confidence in mathematics. Celsi's mathematical identity had not changed much, almost to say stable from the beginning of group learning.

Lala "survival"

Lala has chosen to be in a "safe" position. The opinions expressed during the discussion did not show input or denial. Lala was a type of student who only did the task if it is given; she was passive and has not too high motivation to learn better. But Lala realized her weakness and tried to find a solution by taking additional lessons. In the circle material discussed in the study group, Lala only expressed things that were general. She did not give any solutions to the problems faced together.

Galuh "surrender"

Galuh's mathematical identity has increased in the third stage. Group learning activities motivated Galuh to learn and find out about circles. This increase in identity needs to be commended because her previous mathematical identity showed that Galuh has a negative attitude toward mathematics. Her habit of directly taking "shortcuts" to solve math problems made her weak in the concept deepening. Galuh's main focus was to finish, whether it's right or not. Reliance on friends is also a factor that made her cannot work well in mathematics. Low motivation to learn plus the excessive use of gadgets made the mathematical identity built by Galuh less developed.

Conclusions

Group learning activities proved that there was a room for increasing understanding of mathematical concepts, learning motivation, developing a mathematical identity and improving achievement for students in elementary school. Although in general mathematics is a "scary" lesson, when students were given the opportunity to solve problems with other strategies, they were able to call mathematics into something positive, for example, "it turns out that mathematics is fun", or "it turns out learning mathematics is not difficult". This designation reflected confidence in mathematics when students do group learning. Therefore, the results of the research at the final stage showed that there was a significant increase in understanding the mathematical concepts that directly affected the improvement of problem-solving skills and the motivation to learn mathematics. The increasing of these two components indirectly affected the development of the mathematical identity that students have.

In this study, it can be said that students did not have deficiencies in the cognitive domain related to mathematics learning. Yet, what they need was recognition, exploration or development of ways of learning according to their abilities and interests. The recommendation that could be given for further research is to use the design of this study on a larger scale with a variety of strategies. This was done, of course, to eliminate the scourge of the lack of motivation to learn mathematics and more importantly to improve understanding and performance of mathematics.

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Math Anxiety in Students With and Without Math Learning Difficulties

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Abstract

The aim of this study was to determine the dimensions of the relationship between math anxiety and mathematics achievement of the third grade students with and without mathematics learning difficulties. Data were collected from 288 elementary school students using math anxiety scale and math achievement test tools. The mathematics achievement test scores reveal that the students were classified into four groups: math learning difficulties (0-10%), low achievers (11-25%), normal achievers (26-95%), and high achievers (96-100%). The findings reveal that there was a strong correlation (r=-.597) between the math anxiety and math achievement of the participants, while there was no significant difference between the mean scores of the mathematics anxiety of the lower two groups as it was between the two upper groups. This indicates that the math anxiety level of the students with math learning difficulties does not differ from the low achievers. However, the results depict a significant difference between the mean scores of the math anxiety of the low achievers and the normal achievers.

Keywords: Math Anxiety, Working Memory, Mathematics Learning Difficulties, Dyscalculia

Introduction

The importance of mathematics in daily and professional life has been increasing with the contribution of developing technology. The level of the mathematical knowledge and skills directly influence the quality standards of our individual and social life. However, mathematics the importance of which we feel in every aspect of our life is unfortunately not learned enough by many individuals for many reasons. The leading reasons regarding this issue are as follows: the abstract and hierarchical structure of mathematics, methods and strategies in learning mathematics, and the learning difficulties in mathematics. Developmental Dyscalculia (DD)/Mathematics Learning Difficulty (MLD) is a brain-based condition that negatively affects mathematics acquisition (Piazza et al., 2010 ;von Aster & Shalev 2007). The mathematical performance of a student with MLD is much lower than expected for age, intelligence, and education, although there are no conditions such as intellectual disability, emotional disturbances, cultural deprivation, and lack of education (Büttner & Hasselhorn, 2011). Difficulties in mathematics result from a number of cognitive and emotional factors. The math anxiety is one of the emotional factors which may severely disrupt a significant number of children and adults of learning and achievement math (Dowker, Sarkar & Looi, 2016).

The math anxiety is defined as "the feelings of tension and anxiety that interfere with the manipulation of numbers and the solving mathematical problems in a wide variety of ordinary life and academic situations" (Richardson & Suinn, 1972, p. 551). Sherard (1981) describes the math anxiety as the fear of math or an intense and negative emotional response to mathematics. There are many reasons for the cause of the math anxiety. These include lack of the appropriate mathematical background of the students, study habits of memorizing formulas, problems and applications that are not related to real life, challenging and time limited exams, lack of concrete materials, difficulty of some subjects in mathematics, type of personality, negative approach on mathematics, lack of confidence, the approaches, feelings, and thoughts of teachers and parents on mathematics (Ashcraft & Ridley, 2005; Finlayson, 2014; Hoffman, 2010; Maloney, Ansari & Fugelsang, 2011; Rubinsten & Tannock, 2010).

The negative relationship between the math anxiety and math performance is an international issue. The PISA (Programme for International Student Assessment) statistics measuring a wide variety of countries and cultures depict that the high level of negative correlation between math anxiety and mathematical performance is remarkable (Foley et al., 2017). Some studies showed that highly math-anxious individuals worse than those with low mathematics anxiety in terms of solving mathematical problems (Ashcraft & Kirk, 2001). These differences are not typically observed in simple arithmetic operations such as 7 + 9 and 6 × 8, but it is more evident when more difficult arithmetic problems are tested (Ashcraft & Kirk, 2001).

The math anxiety is associated with the cognitive information processing resources during arithmetic task performance in a developing brain (Young, Wu & Menon, 2012). It is generally accepted that the math anxiety affects negatively the mathematical performance by distorting sources of working memory (Ashcraft & Kirk, 2001; Beilock & Carr, 2005; Young, Wu & Menon, 2012). The working memory is conceptualized as a limited source of cognitive systems responsible for the temporary storage and processing of information in momentary awareness (Baddeley & Hitch, 1994).

The learning difficulties in mathematics relate to deficiencies in the central executive component of the working memory (Geary, Hoard, Byrd-Craven, Nugent, & Numtee, 2007; Passolunghi & Siegel, 2004). Many studies suggest that individuals with learning difficulties in mathematics have lack of the working memory (Geary, Hoard, Byrd-Craven, & DeSoto, 2004; Wilson & Swanson, 2001). It is stated that students

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with learning difficulties in mathematics use more inferior strategies than their peers for solving basic (4 + 3) and complex (16 + 8) addition, and fall two years behind of their peers while they fall a year behind in their peers' working memory capacities (Geary, Hoard, Byrd-Craven, & DeSoto, 2004).

Highly math-anxious individuals showed smaller working memory spans, especially when evaluated with a computationally based task. This reduced working memory capacity, when implemented simultaneously with a memory load task, resulting in a significant increase in the reaction time and errors (Ashcraft & Kirk, 2001). A number of studies showed that working memory capacity is a robust predictor of arithmetic problem solving and solution strategies (Geary, Hamson, & Hoard, 2000; De Smedt et al., 2009; Passolunghi, Vercelloni, & Schadee, 2007).

Although it is not clear to what extent the math anxiety affects the mathematical difficulties and how much of the experience of mathematical difficulties cause mathematical anxiety, there is considerable evidence that math anxiety affects the mathematical performance that requires working memory (Dowker et al., 2016). Figure 1 below depicts these reciprocal relationships among math anxiety, poor math performance, and lack of working memory. The findings of the studies mentioned above, make it possible to draw this figure.

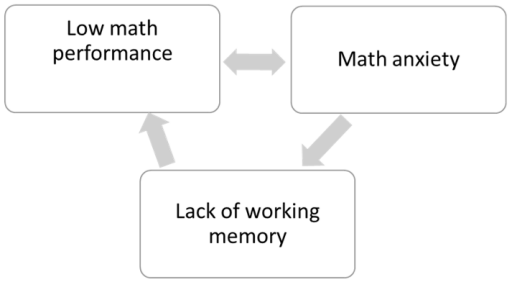

Figure 1. The relationships among poor mathematical performance, math anxiety, and working memory

Basic numerical and mathematical skills have been crucial predictors of an individual's vital success. When anxiety is controlled, it is seen that the mathematical performance of the students increases significantly (Kamann, Wong 1993; Maloney & Beilock 2012). Hence, early identification and treatment of the math anxiety is of importance. Otherwise, early anxieties can have a snowball effect and eventually lead students to avoid mathematics courses and career options for math majors (Ramirez et al., 2013). Although many studies (Harari, Vukovic, & Bailey, 2013; Mutlu, Söylemez, & Yasul, 2017; Krinzinger, Kaufmann, & Willmes, 2009; Vukovic, Kieffer, Bailey, & Harari, 2013;) confirm that math anxiety is present at high levels in primary school children, it is seen that the studies conducted at this level are relatively less when the literature of math anxiety is examined. In this context, this study aims to determine the dimensions of the relationship between math anxiety and mathematics achievement of third graders by their mathematics achievement levels.

Methods

The study was conducted by descriptive method. The purpose of the descriptive method is to reveal an existing situation as it is. This study aims to examine the relationship between math anxiety and mathematics achievement of third graders in primary school in terms of the student achievement levels.

Participants

Researchers of mathematics learning difficulties (MLD) commonly use cutoff scores to determine which participants have MLD. These cutoff scores vary between -2 ss and -0.68 ss (Devine, Soltesz, Nobes, Goswani and Szucs, 2013). Some researchers apply more restrictive cutoffs than others (e.g., performance below the 10th percentile or below the 35th percentile) (Murphy et al. 2007). The present study adopted the math achievement test (Fidan, 2013) to determine children with MLD based below the 10th percentile. The unit of analysis was third graders of an elementary school located in a low socioeconomic area. The study reached 288 students using math anxiety scale and math achievement test tools. The students were classified into four groups by their mathematics achievement test scores: math learning difficulties (0-10%), low achievers (11-25%), normal achievers (26-95%), and high achievers (96-100%).

Table 1. *Distribution of participants by gender and groups*

Groups	Gender		Total
	Boys	Girls	
MLD	20	9	29
LA	21	22	43
NA	102	99	201
HA	5	10	15
Total	148	140	288

Data Collection Tools

Two copyrighted survey scales, consisting of 29 items were used to construct a survey questionnaire. The first scale is the Math Anxiety Scale developed by Mutlu & Söylemez (2017) for 3rd and 4th graders with a 3-factor structure of 13 items. The Cronbach's Alpha coefficient is adopted by the study to evaluate the extent to which a measurement produces reliable results at different times. The Cronbach Alpha coefficient of the scale is .75 which confirms the reliability of and internal consistency of the study. The response set was designed in accordance with the three-point Likert scale with agree, neutral, and disagree. Of the 13 items in the scale, 5 were positive and 8 were negative. Positive items were rated as 3-2-1, while negative items were rated as 1-2-3. The highest score on the scale was 39 and the lowest on the scale was 13.

The second data collection tool adopted by this study is the math achievement test for third graders developed by Fidan (2013). It has 16 items designed in accordance with the national math curriculum. Correct responses were scored one point while wrong responses were scored zero point.

Data Analysis

The study mainly utilized five statistical analyses which are descriptive analysis, independent samples *t*-test, Pearson product-moment correlation analysis, linear regression and ANOVA. First, an independent samples *t*-test was performed to determine whether there was a significant difference between the levels of math anxiety by gender. Then, a Pearson product-moment correlation analysis was performed to determine the relationship between the math anxiety and mathematics achievement of the students. After that, a linear regression analysis was performed to predict mathematics achievement of the participants based on the math anxiety. Finally, an ANOVA was performed to determine if there was a significant difference between the math anxiety of the groups determined in terms of mathematics achievement.

Results

The findings of the math anxiety scores by gender of the study found no significant difference between the averages [$t(286)= 1.790$, $p< .05$]. This result shows that the math anxiety levels of girls and boys are close to each other. Since there is no difference between math anxiety scores by gender, the data in the study were combined.

Table 2. *Comparison of anxiety scores by gender*

Gender	*N*	*M*	*Sd*	*df*	*t*	*p*
Girls	148	1.55	0.38	7	1.790	.075
Boys	140	1.47	0.37	7		

There was a strong and negative correlation between math anxiety and mathematics achievement with the values of $r= -0.597$, $n= 288$, and $p= .00$. This result indicates that the highly math-anxious students and decreases in math anxiety were correlated with increases in rating of math achievement.

A simple linear regression was calculated to predict math achievement level based on the math anxiety. A significant regression equation was found ($F_{(1,286)}= 158.691$, $p< .000$) with an R^2 of .357. Participants' predicted math achievement is equal to 20.153 + -6.611 when math anxiety is measured in unit. Math achievement decreased -6.611 for each unit of the math anxiety.

Figure 1 below shows the relationship between the math anxiety of the children and their mathematics achievement on a group basis. Figure 1 provides us that there is a negative correlation between mathematical performance and math anxiety. The results depict that the HA group has the lowest math anxiety score, while the MLD group has the highest math anxiety.

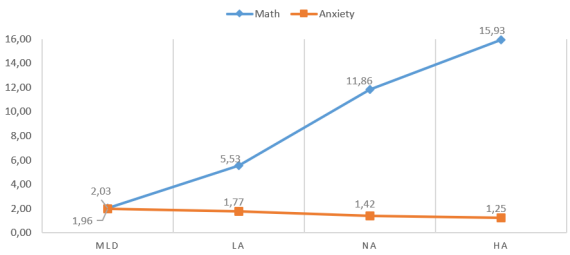

Figure 2. Group's math and math anxiety scores

Table 3. *Comparison of the mathematical anxiety scores of the groups*

	Sum of Squares	*df*	Mean Square	*F*	*p*
Between Groups	11.558	3	3.853	36.584	.000
Within Groups	29.907	284	.105		
Total	41.464	287			

The table indicates that there is a statistically significant difference between groups as determined at the $p<.05$ level by one-way ANOVA ($F_{(3,284)}= 36.584$, $p= .000$). Post hoc comparisons using the Tukey test indicated that the mean score for MLD group ($M= 1.96$, $sd= 0.30$) was significantly different than the NA group ($M= 1.41$, $sd= 0.84$) and HA group ($M= 1.24$, $sd= 0.28$). However, the MLD group ($M= 1.96$, $sd= 0.30$) did not significantly differ from the LA group ($M= 1.76$, $sd= 0.27$).

Discussion and Conclusion

Math anxiety is a problem that can affect adversely the academic success and employment prospects of the children. Although the literature on math anxiety is largely focused on adults, recent studies have reported that some children begin to encounter the math anxiety at the elementary school level. (Krinzinger, Kaufmann & Willmes, 2009; Harari, Vukovic & Bailey, 2013; Mutlu, Söylemez & Yasul, 2017). The findings of the study depict that the correlation level of math anxiety and math achievement is -.597 among students. In a meta-analysis study of Hembre (1990) and Ma (1999), found that the level of relationship between mathematical success and math anxiety is -.34 and -.27, respectively. In a similar meta-analysis study performed in Turkey, the correlation coefficient was found to be -.44 (Sad, Kis, Demir, & Özer, 2016). The different occurrence of the coefficients is probably dependent on the scales used and the sample variety.

The participants of the study were classified into four groups: math learning difficulties (0-10%), low successful (11-25%), normal (26-95%), and high successful (96-100%) by the mathematics achievement test scores. The study compared the math anxiety scores of the groups and found no significant difference between the mean scores of the math anxiety of the lower two groups (mean of MLD math anxiety, .196; mean of LA math anxiety .177) as it was between the upper two groups (mean of NA math anxiety, .142; mean of HA math anxiety .125). This indicates that the math anxiety level of the students with learning difficulties in math does not differ from the low math students. However, a significant difference was found between the mean scores of math anxiety of the low successful and the normal group.

It may be better for some students to maintain moderate levels of math anxiety, for making their learning and testing materials moderately challenging (Wang et al. 2015) but it can be clearly said that high math anxiety has detrimental effects on the mathematical performance of the individuals. Especially for students with learning difficulties in math, the high level of math anxiety will lead to destructive effects in many dimensions, primarily lack of working memory.

Many of the techniques employed to reduce or eliminate the link between the math anxiety and poor math performance involve addressing the anxiety rather than training math itself (Maloney & Beilock 2012). Some methods for reducing math anxiety can be used in teaching mathematics. For instance, effective instruction for struggling mathematics learners includes instructional explicitness, a strong conceptual basis, cumulative review and practice, and motivators to help maintain student interest and engagement (Fuchs et al., 2008; Gersten et al., 2009).

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Investigation of the Effect of Social Skills Training on the Motivation Levels of Preschool Children*

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Abstract

This study was carried out in order to determine the effects of Social Skills Training Program applied to 16 children between 48 and 60 months old children's motivation levels. The social skills program included behaviors such as cooperation, social interaction, empathy, sharing, and management of feelings and social maladaptation. A personal information form and the Dimensions of Mastery Questionnaire (DMQ18) for Preschool Children were used as data collection tools in the study. Social Skills Training Program was implemented for the children for 14 weeks, two days a week. between pre-test and post-test scores. Results show that there was a significant difference in the motivation levels of the children who completed the Social Skills Training Program and the effect of the program was permanent. By considering the contribution of social skills training programs to motivation in preschool education institutions, their restructuring can be suggested. Awareness training can be provided to families for contributing to the motivation levels of children by supporting their social skills.

Keywords: Social Skills, Preschool Education, Child, Motivation

Introduction

Social skills enable an individual to express positive or negative emotions and thoughts in social environments without any loss of social support, and they have an important effect on both the social-emotional development and cognitive and academic skills of children in the long term. Failure to sufficiently develop social skills may have negative impacts throughout the whole life of a child (McCellan & Katz, 2001; Danielson & Phelps, 2003; Choi & Kim, 2003).

There are several definitions of social skills based on the content covered by different fields, including social services, psychology, education, and special education programs. Social skills are a series of behaviors that can be intentionally repeated towards an objective (Bacanlı, 1999). Gresham and Elliot (1984: cit. Caldarella & Merrill, 1997) define social skills in three different ways as behavior of children that can be accepted by peers, as responsibility in specific cases created by reducing penalties and increasing positive support, and as behavior in specific cases with positive outcomes including being popular among peers and having general acceptance in society. Samancı and Uçan (2017) describe social skills as learned behaviors that include verbal and non-verbal behaviors and that ensure that an individual start and maintains positive behaviors and develops reactions in accordance with the social environment. Social skills include problem-solving, decision-making, and self-management, and they help a child to establish and maintain positive social relations in social environments with family, friends, and schoolmates and to achieve social adaptation with easier acceptance among friends (Özyürek, 2015; Zembat, Yılmaz & İlçi Küsmüş, 2018).

Marlowe (1986) defines social skills as the skills of an individual to understand the emotions, thoughts, and behaviors of people, including the individual himself or herself, in interpersonal situations, and the ability to behave in accordance with this understanding (cit. Genç, 2005). Social skills are the ability of an individual to demonstrate behaviors in a social environment that may be useful for the individual and others (Kozanoğlu, 2006). According to Kapıkıran, Bora İvrendi, and Adak (2005), social skills allow us to start and to maintain positive interactions with others, including communication, problem-solving, decision-making, self-management, and peer relations. Social skills are behaviors that can be observed and defined and that develop the social competence of an individual. Social skills are a part of a broad structure that is known as social competence (Warger & Rutherford, 1993; Johns, Crowley & Guetzloe, 2005). Various factors including inheritance, family, education, and social values play an effective role in acquiring social competence. The interaction of a newborn baby with various adults, including the mother, is essential as the first step of social development. Children's social skills are negatively affected when parents' attitudes are authoritarian or permissive, and positively affected when parents have a democratic attitude (Ogelman, Önder, Seçer & Erten, 2013). This social interaction in the first developing years of life also has a positive effect on linguistic and cognitive development (Abalı Öztürk & Demir, 2018; Jamison, Forston & Stanton-Chapman, 2012; Neslitürk & Deniz, 2014; Oden, 1987). Likewise, Kupersmidt, Voegler-Lee, and Marshall (2012) found that the academic achievements of children with poorer social skills are lower and that children with strong social skills have higher academic achievements.

Caldarella and Merrill (1997) classified social skills as relations with peers, self-control, and academic and assertiveness skills. Social skills play an effective role in the communication of an individual with both oneself and others, and in displaying several behaviors including taking responsibility, sharing, solidarity, obeying rules, making friends, solving problems, controlling emotions, and cooperating. In parallel to this, studies reveal that poor social skills are associated with increased exposure to peer victimization, inefficacy in maintaining quality and ease of daily social interaction skills, and poor academic achievement (Fox & Boulton, 2005; Rigby, 1998; Smith & Sharp 1994; Rigby, Simith & Pepler, 2004; Özbey, 2009).

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Social skills are based on individual and moral values. The values system that is deeply rooted in one's personality plays a key role in the decisions of an individual regarding how to successfully manage his or her own life (McArthur, 2002). Some values vary according to culture and time. On the other hand, core values and beliefs including integrity, responsibility, righteousness, benevolence, respect, self-confidence, patience, self-control, and independence, which are considered to be universal and intercultural common values, guide the lives of individuals (Uyanık Balat, 2004, 2007; Uyanık Balat & Balaban Dagal, 2007)

Lack of social skills may result in various problems in many areas for children, including self-confidence, self-control, responsibility, problem-solving, patience, persistence, perception of self-efficacy, and interpersonal relations. Social skills are the basis of social competence. Social competence is an evaluative term based on the question of whether the individual behaves in accordance with the criteria determined by the society that he or she lives in. Social competence is considered to be one of the basic human skills (Turhan & Vuran, 2015). Lack of social skills have a negative impact on the motivation of children in both academic and social fields. Studies reveal the interrelations of motivation, social relations, and academic achievement (Dinçer, 2019; Wentzel, 1998). Motivation is a natural instrument that guides a child to discover his or her environment (Busch-Rossnagel, Knauf-Jensen & DesRosiers, 1995; Dichter-Blancher, Busch-Rossnagel & Knauf-Jensen, 1997). Motivation is accepted to be a product of social learning and the effective communication of an organism with the environment. Studies reveal that social environment has a significant effect on the development of top-level motivation (Messer, 1993; Morgan, Maslin-Cole, Harmon, Busch-Rossnagel, Jennings, Hauser-Cram & Brockman, 2016). Looking at the characteristics of children with high levels of motivation, we notice that various qualities including patience, persistence, self-efficacy, self-esteem, positive sense of self, problem-solving, and self-control intersect with social skills. Motivation is defined as a psychological power that encourages focused and persistent independent initiatives of a person to solve a problem or achieve a moderately challenging skill or task (Morgan, Harmon & Maslin-Cole, 1990). That psychological power prompts a child to explore from an early age. Providing children with external awards to achieve a goal in the process of curiosity, exploration, and discovery reduces internal motivation for target-oriented behaviors (Eccles & Wigfield, 2002).

Theories that attempt to explain internal motivation can be divided into 3 categories: cognitive theory, competence theory, and association theory. Cognitive theoreticians argue that children are more prone to development when they face new and complex situations triggering their desire for exploration and discovery, and that this complexity produces internal motivation in children. According to Piaget, internal motivation is a part of the cognitive change process. When children have a new experience that cannot be assimilated in their cognitive structures, they experience cognitive imbalance. This imbalance is reduced when the child creates new cognitive structures. The noncompliance between a new stimulus and the current knowledge produces internal motivation. Cognitive theoreticians such as Piaget and Hunt state that internal motivation is a product of cognitive processing (Hunt, 1971; Mischel, 1971; cit. Gottfried, 1983). Exposure to a new environment with various stimuli increases internal motivation; however, the special stimuli producing internal motivation vary for each child since it is believed that cognitive conflict may only exist in relation with the current knowledge of the child. Therefore, environmental factors are considered to be important in internal motivation. Association theory is concerned with how children perceive the reason for their behaviors. The internal motivation of children will probably increase when they obtain a satisfactory outcome as a result of their own competence, efforts, and systematic work towards a certain goal. On the other hand, internal motivation will probably decrease when the cause of the behaviors of children is attributed to extrinsic factors including rewards, parents, and teachers rather than their own efforts. In cognitive, competence, and association theories, children are not considered to have high or low internal motivation. Rather, their motivation varies depending on the fields and conditions of certain contents that affect cognitive conflict, competence, or association. Theoreticians of competence give importance to the environment as the essence of the internal motivation of children. White (1959) recommends that children should have effective interaction with their environment and that selectiveness, persistence, and discovery are the indicators of internal motivation. Harter (1978) differentiates cognitive, social, and physical environments that may support the emergence of competence in a child and attempts to strengthen the theory of White (1959) by highlighting the role of teachers and parents in the development of internal motivation (Gottfried, 1983). Positive social support for children from their peers, teachers, and families has a positive effect on motivation (Wentzel, 1998).

In self-determination theory and cognitive evaluation theory, Deci and Ryan (1985) explain the factors in social contexts creating variance in internal motivation. Self-determination theory suggests that the supporting factors should be clearly defined in order to provide the necessary conditions for the healthy development of individuals, groups, and society. People are active creatures who have the potential to develop themselves psychological and who make efforts to overcome the obstacles they face (Ryan & Deci, 2000). In self-determination theory, there is emphasis on psychological requirements that are accepted to be universal, including autonomy, competence, and association. These psychological needs have to be satisfied so that individuals can develop themselves. At this point, it is important that the environment of the individual supports independence. Autonomy refers to the display of behaviors by an individual by making choices. Autonomy is the acceptance, approval, and backing of an individual for his or her own behaviors and his or her guidance of these behaviors. It is more important than the needs of competence and association. The requirement for competence is defined to be the desire of an individual to have effective interactions with and positive impacts on others. The competence requirement is the sum of the acquisitions of an individual after a life of learning and his or her compliance to the environment. Acquiring a feeling of competence strengthens the self-belief of an individual to reach a goal. The requirement for association includes an individual's feeling of belonging to the social environment, and affection, respect, trust, and social-emotional acceptance in interpersonal relations (Cihangir Çankaya, 2009). The concerned feeling of belonging provides a significant contribution to the motivations of children by allowing them to develop a positive sense of self. Likewise, Türkmen and Özbey (2018) find a positive relation between the sense of self of children and their motivation levels. In his two-factor theory of 1960, Frederick Herzberg states that motivation is affected by internal and extrinsic factors. He states that the intrinsic factors affecting internal motivation are autonomy, self-realization, responsibility, and self-esteem. In other words, internal motivation is strengthened by the satisfaction of development requirements (Kaya, Yıldız & Yıldız, 2013; Koyuncu, 2016).

Examining the theories explaining internal motivation, one can conclude that internal motivation is strengthened or weakened proportionally with the development of personality. Qualities including independence, responsibility, affection, respect, trust, positive interaction with the envi-

ronment, and social-emotional acceptance are said to be the intrinsic factors that are effective within that process, and they can be evaluated as the social skills that an individual needs to acquire. Gresham and Elliott (1984: cit. Caldarella & Merrill, 1997) define social skills to be behaviors of children that are accepted by peers and that have positive outcomes, including being popular among peers and general acceptance in society. Kapıkıran et al. (2005) define social skills to be the skills that allow starting and maintaining positive social relations with others, including communication, problem-solving, decision-making, self-management, and peer relations. Taking these definitions into consideration, one can conclude that the acquisition of social skills has an important role in the development and support of internal motivation, and that social skills support internal motivation and vice versa. Likewise, studies show that motivation has a significant role in predicting social competence beginning in the period of early childhood and that there is a positive relation between motivation and positive social behaviors, including social skills, self-organization, and value behaviors (Huang & Ling Lay, 2017; Jambunathan, Burts & Pierce, 1999; Józsa and Barett, 2018; Özbey, 2018a, 2018b; Özbey & Aktemur Gürler, 2019).

In parallel to this idea, it is believed that the development of social skills starting from the preschool period may significantly support the internal motivation that already exists in children. Therefore, this study was conducted to reveal the extent of the effect of social skills education for preschool children on their internal motivation. This study is important as it is the first study that reveals the effect of a motivation-oriented education program in preschools, which is a new subject of study in our country.

Method

Research Model

The research included the application of a social skills education program and measured the effectiveness of this program on the internal motivation of children. Therefore, the experimental model was a one-group pretest-posttest semi-experimental design without a control group. This model is one of the pre-experimental models. In this model, the independent variable is applied to a randomly selected group. There is no randomness or matching. The design can be defined as the repeated measures design or one-factor design within groups. The design includes the testing of the significance of the differences between pretest and posttest values of a single group. The reason for excluding a control group in the study is the fact that there is no other classroom in the same age group in the school where the test group is located (Karasar, 2010). Since the test group was found to be remarkable with poor social skills and low motivation, it was selected as a group for which the Social Skills Training Program would be implemented.

Study Group

The study group in this research consisted of 16 children aged 48-60 months attending preschool. Of these children, 6.25% were 51 months old (*n*= 1), 18.75% were 52 months (*n*= 3), 12.50% were 54 months (*n*= 2), 12.50% were 55 months (*n*= 2), 18.75% were 56 months (*n*= 3), 18.75% were 57 months (*n*= 3), and 12.50% were 58 months (*n*= 2). Additionally, 43.75% of the children were girls (*n*= 7) and 56.25% were boys (*n*= 9).

Data Collection Tools

A personal information form and the Motivation Scale for Preschool Children were used as the data collection tools (Dimensions of Mastery Questionnaire: DMQ18). The personal information form included information on the demographic characteristics of the children.

The Motivation Scale for Preschool Children (DMQ18) was developed by Morgan, Maslin-Cole, Harmon, Busch-Rossnagel, Jennings, Hauser-Cram, and Brockman (1993). The scale was revised by Jozsa and Morgan (2015) and validity and reliability studies of the DMQ18 version of the scale were performed (Morgan, Wang, Barrett, Liao, Wang, Huan & Jozsa, 2015). The scale is a 5-point Likert-type scale, where 1 = not at all likely and 5 = very likely. The scale is completed by the teachers on behalf of the children. High scores from the scale signify high motivation levels and low scores signify low motivation levels. The DMQ18 was revised in 2015 and it consists of 7 subscales including the Cognitive Persistence, Gross Motor Persistence, Social Persistence with Adults, Social Persistence with Children, Mastery Pleasure, Negative Reactions, General Competence. There are a total of 39 items in the scale. The load value of the items varies between .51 and .94. The total variance represented by the factors is .71.

The adaptation study of the Motivation Scale for Preschool Children for Turkish children in the age group of 36-72 months was done by Özbey and Dağlıoğlu (2017). The language validity of the scale was examined by six linguists and four academicians with a command of two languages and knowledge of the field of preschool education. Necessary adjustments were made to the scale items. Four academicians working in the field of preschool education at universities were also consulted to evaluate the scope of the scale items and their compliance with Turkish culture. The scale items were made ready for implementation after obtaining the opinions of the four specialists and they were finalized after testing for comprehensibility by five preschool teachers. The seven-factor structure of the scale was confirmed by confirmatory factor analysis. The confirmatory factor analysis included the examination of the standardized solutions and t values. After the compliance indices of the scale were evaluated, it was found that the scale provides data compliance for the seven-factor structure of the adapted scale. The alpha reliability coefficients of the scale vary between.84 and .91 while the Spearman-Brown split-half test reliability coefficients vary between .77 and .90. The test-retest reliability coefficient of the scale is .85 (*n*= 30).

In 2018, a validity and reliability study of the Motivation Scale for Preschool Children was conducted again in children aged between 36 and 72 months (*n*= 401) who attended preschools in Ankara. The seven-factor structure of the scale was confirmed after confirmatory factor analysis of the scale; the degree of freedom of the model χ^2=2311, 91 was found to be (*df*)= 681, and χ^2=/*df*= 3, 39. Among the other goodness-of-fit indices of the scale, it was found that REMSEA= 0.077, SRMR= 0.052, RMR= 0.067, NNFI= 0.98, NFI= 0.97, CFI= 0.98, and GFI= 0.77. When the fit indices of the scale were evaluated, data fit was achieved for the seven-factor structure of the scale and the model was found to be statistically significant (p< .01) (Çokluk et al., 2010; Schermelleh-Engel, Moosbrugger & Müller, 2003). Pearson correlation analysis was conducted to determine the interrelation of the subscales and it was found that the subscales have medium and top-level relations (p< .01). The alpha reliability coefficients of the scale were found to be 0.91 for the subscale of cognitive persistence, 0.88 for the subscale of gross motor persistence, 0.90 for the subscale of social persistence with adults, 0.87 for the subscale of social persistence with children, 0.87 for the subscale of high satisfaction, 0.81 for the subscale of negative feelings, and 0.93 for the subscale of general competence. The alpha reliability coefficients of the scale in this study vary between 0.82 and 0.90 (cognitive persistence 0.90;

gross motor persistence .90; social persistence with adults .90; social persistence with children .88; high satisfaction .86; negative feelings .82; and general competence .90).

Implementation Process of the Program

The Social Skills Training Program was developed by Özbey (2009). In the program development process, education programs drafted for social skills, problem-solving, and violence prevention were examined from among foreign preschool education programs for providing social skills and coping with problematic behaviors. The methods and techniques frequently used in the relevant education programs were taken into consideration. An attempt was made to create a child-centered program based on effective learning by taking contemporary education approaches into consideration, which are the sources of the basic philosophy of the 2013 Preschool Education Program. Therefore, game-based activities were planned, where children participate actively with the five senses and have fun. The social skills program was reviewed and revised based on activity planning for the 2013 Preschool Education Program.

While preparing the activities, the outcomes and indicators of the 2013 Preschool Education Program of the Ministry of National Education were selected. A part of the cards including stories and problem cases involving social skills was translated from English and the content was re-organized while taking the education program and compliance with Turkish culture into consideration. Within the scope of the social skills program, skills like communication skills, responsibility, respect, expression of feelings and emotion management, empathy, and courtesy rules were included. Opinions of three specialists on the scope of the program were obtained and the program was finalized with the recommended adjustments. The program includes 74 activities in total. Activities of the social skills program consist of those in the fields of Turkish language, music, drama, science, games, and art within an educational period of a half day. A minimum of three activities were applied within the daily education period. The implementation process of the activities varies between one hour and a half and two hours.

The motivation scale was filled in by the teacher separately for each child in order to measure their motivation levels before the social skills program. After the pretest, the program was applied by the researchers for 14 weeks, 2 days per week. The program was evaluated every week and the program for the next week was adjusted accordingly. The program included family participation activities, as well. After the implementation, the motivation scale was filled in again by the teacher separately for each child in order to measure the effectiveness of the program. A permanency test was conducted 4 weeks after the program was completed.

Data Analysis

The Wilcoxon signed-rank test was conducted to determine the score differences between the pretests and posttests of the children in order to determine the effects of the social skills program on the motivation levels of the children. The Friedman test was conducted to determine the difference between the pretest and permanency test. Descriptive statistics for the measurements were calculated, as well.

Findings

This section includes the analyses of the pretest-posttest and permanency tests for the Social Skills Training Program. Table 1 includes the results of the Wilcoxon signed-rank test, which was conducted to determine the differences between the scores of children from the pretests and posttests.

When we examine Table 1, it is seen that that there is a significant difference in favor of positive ranks, i.e. the posttest, among the children's scores from all subscales of the Motivation Scale questionnaire before and after the social skills education ($p < .05$). In other words, it is possible to say that the social skills education made a significant contribution to the motivation levels of the children. Table 2 includes the results of the Friedman test, conducted to determine the differences between the scores of children from the pretest-posttest and permanency tests.

According to Table 2, there was a significant difference in motivation levels after the children received social skills training ($p < .05$). Mutual comparisons were made between the motivation scores of the groups with the Wilcoxon signed-rank test to determine the causes of the significant

Table 1. *Wilcoxon signed-rank test results for the pretest and posttest scores of the children attending social skills education based on the Motivation Scale for Preschool Children*

Motivation Scale	*Posttest-Pretest*	*n*	*Rank Ave.*	*Rank Total.*	*z*	*p*
Cognitive Persistence	Negative Ranks	0	.00	.00	-3.522*	.000**
	Positive Ranks	16	8.50	136.00		
	Equal	0				
	Total	16				
Gross Motor Persistence	Negative Ranks	1	2.00	2.00	-3.417*	.001**
	Positive Ranks	15	8.93	134.00		
	Equal	0				
	Total	16				
Social Persistence with Adults	Negative Ranks	0	.00	.00	-3.411*	.001**
	Positive Ranks	15	8.00	120.00		
	Equal	1				
	Total	16				
Social Persistence with Children	Negative Ranks	0	.00	.00	-3.532*	.000**
	Positive Ranks	16	8.50	136.00		
	Equal	0				
	Total	16				

Table 1 (Cont.). *Wilcoxon signed-rank test results for the pretest and posttest scores of the children attending social skills education based on the Motivation Scale for Preschool Children*

Motivation Scale	*Posttest-Pretest*	*n*	*Rank Ave.*	*Rank Total.*	*z*	*p*
Mastery Pleasure	Negative Ranks	0	.00	.00	-3.529*	.000**
	Positive Ranks	16	8.50	136.00		
	Equal	0				
	Total	16				
Negative Reactions	Negative Ranks	1	4.50	4.50	-3.285*	.001**
	Positive Ranks	15	8.77	131.50		
	Equal	0				
	Total	16				
General Competence	Negative Ranks	2	1.50	3.00	-3.366*	.001**
	Positive Ranks	14	9.50	133.00		
	Equal	0				
	Total	16				

* Based on negative ranks.

**Significant difference (p<0.05).

Table 2. *Results of the Friedman test regarding the pretest-posttest and permanency tests according to the scores of the children attending social skills education based on the Motivation Scale for Preschool Children*

Motivation Scale	Test	*n*	*sd*	Rank Avg.	χ^2	*p*
Cognitive Persistence	Pretest	16	2	1.00	26.839	.000*
	Posttest			2.25		
	Permanency Test			2.75		
Gross Motor Persistence	Pretest	16	2	1.09	21.593	.000*
	Posttest			2.38		
	Permanency Test			2.53		
Social Persistence with Adults	Pretest	16	2	1.03	23.524	.000*
	Posttest			2.34		
	Permanency Test			2.63		
Social Persistence with Children	Pretest	16	2	1.00	25.733	.000*
	Posttest			2.44		
	Permanency Test			2.56		
Mastery Pleasure	Pretest	16	2	1.00	27.263	.000*
	Posttest			2.41		
	Permanency Test			2.59		
Negative Reactions	Pretest	16	2	1.06	21.125	.000*
	Posttest			2.44		
	Permanency Test			2.50		
General Competence	Pretest	16	2	1.25	15.193	.001*
	Posttest			2.41		
	Permanency Test			2.34		

*p< .05

difference. As a result of the analysis, it was found that the motivation scores between the pretest and posttest were in favor of the latter and between the permanency test and pretest were in favor of the former. No significant difference was found between the posttest motivation scores and permanency test motivation scores of the children. These findings show that the Social Skills Training Program provided significant contributions to the children's motivation levels and that this contribution was permanent. Table 3 includes the Wilcoxon signed-rank test results for scores of the posttest and permanency tests that were conducted to determine the permanency of the social skills education.

When we look at Table 3, it is seen that there is no significant difference between the scores of the children from all subscales of the Motivation Scale before and after the social skills education (p> .05). This result can be interpreted such that the children also maintained the increase in their motivation levels after the social skills education in the permanency test. The fact that the children also maintained the effects of social skills education on their motivation levels in the permanency test shows that the effects of the program are permanent. Table 4 includes the descriptive statistics from the pretest and permanency tests of the children receiving social skills education.

Table 3. *Wilcoxon signed-rank test results related to the scores of the posttest and permanency tests of the children attending social skills education based on the Motivation Scale for Preschool Children*

Motivation Scale	*Permanency Test-Posttest*	*n*	*Rank Ave.*	*Rank Total.*	*z*	*p*
Cognitive Persistence	Negative Ranks	3	9.83	29.50	-1.459	0.145
	Positive Ranks	11	6.86	75.50		
	Equal	2				
	Total	16				
Gross Motor Persistence	Negative Ranks	5	6.40	32.00	-0.551	0.581
	Positive Ranks	7	6.57	46.00		
	Equal	4				
	Total	16				
Social Persistence with Adults	Negative Ranks	6	10.00	60.00	-0.416	0.678
	Positive Ranks	10	7.60	76.00		
	Equal	0				
	Total	16				
Social Persistence with Children	Negative Ranks	5	6.70	33.50	-0.438	0.662
	Positive Ranks	7	6.36	44.50		
	Equal	4				
	Total	5	6.70	33.50	-0.438	0.662
Mastery Pleasure	Negative Ranks	3	3.83	11.50	-1.327	0.185
	Positive Ranks	6	5.58	33.50		
	Equal	7				
	Total	16				
Negative Reactions	Negative Ranks	8	8.50	68.00	0.000	1.000
	Positive Ranks	8	8.50	68.00		
	Equal	0				
	Total	16				
General Competence	Negative Ranks	5	6.00	30.00	-0.892	0.372
	Positive Ranks	4	3.75	15.00		
	Equal	7				
	Total	16				

Table 4. *Descriptive statistics of scores of the children attending social skills education from the pretest and permanency tests of motivation skills*

Motivation Scale	Test	*n*	Mean.	*sd*
Cognitive Persistence	Pretest	16	12.93	4.69
	Posttest		19.31	3.21
	Permanency Test		20.56	4.08
Gross Motor Persistence	Pretest	16	13.75	6.03
	Posttest		20.00	4.85
	Permanency Test		20.68	5.23
Social Persistence with Adults	Pretest	16	11.87	5.54
	Posttest		18.06	4.20
	Permanency Test		18.43	4.85
Social Persistence with Children	Pretest	16	16.31	3.11
	Posttest		24.00	2.70
	Permanency Test		24.06	3.98
Mastery Pleasure	Pretest	16	16.93	3.02
	Posttest		24.00	1.09
	Permanency Test		24.43	.96
Negative Reactions	Pretest	16	21.12	5.37
	Posttest		31.68	4.77
	Permanency Test		31.92	4.13
General Competence	Pretest	16	14.12	5.50
	Posttest		20.75	4.72
	Permanency Test		20.06	5.72

Discussion and Results

This study examined the effects of social skills education on motivation levels when applied for children aged between 48 and 60 months attending preschool. A significant difference in favor of the posttest was determined between the pretests and posttests applied to the children after the social skills education program. The permanency test showed the permanency of the education program that was applied (Tables 1-3).

In several studies on the relation between motivation and behavior, it was found that the motivation levels of children who display negative social behaviors including aggressiveness and hyperactivity were low. On the other hand, it was found that there was a positive relation between positive social behaviors and motivation levels and a negative relation between negative social behaviors and motivation levels. Earlier studies included the finding that both girls and boys with problematic behaviors have low motivation levels (Morgan, Yang, Griego, Barett & Harmon, 1998; Goldberg, 1994).

Kowalski, Stipek, and Daniels (1987) state that children with negative behaviors are more extrinsic motivation-oriented and therefore low intrinsic motivation is related to negative social behaviors (cit. Goldberg, 1994). Özbey (2018a) found that there is a positive relation between the motivation levels and value behaviors of preschool children including responsibility, working in cooperation, and decent self-expression.

Hopp, Horn, Cheryl, McGraw, and Mayer (2000) state that the development of interpersonal skills and a sense of responsibility forms the basis for children to acquire the skill of controlling their own behaviors. Studies have demonstrated that the motivation levels of children who can control their own behaviors are high. Likewise, Özbey (2018b) and Berhenke (2013) found that there is a positive relation between the self-organization skills and motivation levels of preschool children. Lee (2014) states that self-organization and motivation are intertwined structures and emphasizes that "high level motivation and self-organization skills are umbrella structures consisting of a series of interrelated subsystems".

Wentzel (1998) states that the development of positive social relations with peers, teachers, and parents has an important effect on the motivation-related objectives of children in both academic and social fields. Studies reveal that the quality of parent-child relations and the social competence of parents have a significant contribution to the social competence of children (Guralnick, 2006; Özabacı, 2006). Wentzel (1998) found that the concerned social relations provide emotional comfort in children and strengthen the motivation that is necessary to reach academic achievement. Lee (2014) highlights that social skills and cognitive skills are able to explain the motivation sources of children and they are important in the development process. Another study directly related to this subject was conducted by Özbey and Aktemur Gürler (2019). They studied the relation between the motivation levels and social skills of preschool children and their problematic behaviors. As a result of the study, a positive relation was found between the motivation levels and social skills of the children. It was also concluded that there was a negative relation between the motivation levels and problematic behaviors of the children.

In this study, a significant difference was found in favor of the last test in the "Negative Reactions" subdimension of the Motivation Scale for Preschool Children. This finding requires further discussion. A significant increase in the negative feeling scores and the fact that children experience feelings including sadness, worry, and anger at a certain level when they fail in a task are considered to be positive. Sayıoğlu (2019) states that "a person may not attempt to do better due to complacency when there is no worry". Likewise, Yalçınsoy (2019) found a positive and high relation between worry and motivation. Therefore, it is possible that a certain amount of increase in negative feelings might contribute positively to the motivation levels of children.

The following recommendations can be made based on the results of this study.

Social skills guide and give meaning to the lives of children. These skills are important for children's personality development. Education on social skills is popular today; however, it is essential to study the quality of these social skills programs with regards to content. In parallel, further studies can be recommended on the development of quality social skills programs that will contribute to children's motivation levels.

In addition to education programs, there are studies that have revealed the importance of teacher efficacy on the social behaviors of children. Teacher efficacy is considered to be important for the motivation levels of children as it would undoubtedly provide positive contributions to the programs prepared by the teachers. Pıştav, Akmeşe, and Kayhan (2015) found that the self-efficacy of preschool children with regards to game teaching varies significantly according to the age of the teacher and that teacher younger than 25 have higher self-efficacy in game teaching. Köyceğiz and Özbey (2018) found that the motivation levels of preschool children varied significantly depending on the university of graduation and seniority levels of teachers. In other words, they determined higher motivation levels for the children in the classrooms of teachers with higher seniority and a bachelor's degree. Upon evaluating all these studies, the importance of teacher training programs and teacher qualities comes to light. Within this scope, awareness education may be provided to preschool teachers regarding the relations of social skills education and motivation. Social skills education may also be provided for the development of intrinsic motivation. Opportunities may be created for practical social skills education programs in addition to theoretical information in teacher training programs. In-service trainings, conferences, and workshops on social skills may be recommended for teachers.

Today, as intrinsic motivation is gradually decreasing at every age and education level, educational activities can be organized for awareness of families on the effect of the development of social skills on motivation instead of choosing extrinsic motivation sources in motivating their children. Teachers and parents may be recommended to plan projects through family participation activities including education and newsletters.

In addition, researchers may be recommended to carry out further studies to determine environmental factors that contribute to motivation. Within this scope, further studies on the contributions of different education programs, classroom environments, and game materials to the motivation levels of children may be recommended.

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Relationship Between Writing Motivation Levels and Writing Skills Among Secondary School Students

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Abstract

The aim of this study was to determine the relationship between the writing motivation levels and written expression skills among secondary school students. The study was carried out using the correlational research model of the quantitative research methods. The study group for this study consisted of 230 students attending three different secondary schools in the fall semester of the 2018-2019 school year. For the selection of the study group, the convenient sampling method of the non-probabilistic sampling methods was used. The data collection tools for this study were the writing motivation scale, the writing evaluation form and a personal information form. The writing studies were assessed separately by three researchers. Statistical analyses were performed on the data collected from the writing motivation scale, which was applied to determine the writing motivation levels of the students, and the writing evaluation form, which was assessed using the writing studies. Based on the findings of this study students with high writing motivation scores had high writing evaluation scores.

Keywords: Writing Skills, Writing Motivation, Writing Study, Secondary School Students

Introduction

The goals of language learning and teaching should be based on the needs of students and society, in-class applications required to meet these needs, activities and processes and the skills and proficiencies that students are required to improve in order to realize all of these aims (Council of Europe, 2001). Language teaching occurs through two basic comprehension-based skills which are listening and reading and two production based skills which are speaking and writing (Karadağ & Maden, 2013). Writing is an important skill that constitutes the last stage of effective language learning achieved through education, similar to reading, included in the narration area of language.

In addition to language skills, writing skills also support students in expanding their thoughts, regulating their knowledge, using the language, enriching their intelligence and improving their mental lexicon by being in touch with mental processes (Güneş, 2013). Students transfer knowledge and review and regulate their thoughts more efficiently as their writing skills improve which consequently enables them to write at higher levels (Akyol, 2013). Bağcı Ayrancı (2013) stated that writing is a production skill and, with this skill, people have the opportunity to explain their thoughts and feelings accurately, efficiently and permanently. In brief, it is possible to assess writing as a skill comprising the processes of expressing emotions, thoughts and information through written communication channels (Carter, Bishop & Kravits, 2002).

Writing is defined as a complicated process involving a range of skills and functions (The Ontario Curriculum Language, 2006) that encompass planning, creating (writing and developing), editing and publishing printed or digital texts (The Australian Curriculum English, 2012). The stages of the process of writing are stated as being planning, creating a draft, reviewing, editing, rereading and publishing (The Ontario Curriculum Language, 2006). According to the Writing and Writing Skills Lesson Curriculum (2018), the writing process was comprised of the preparation, planning, developing, editing and presentation stages. Many researchers have also stated that writing is a skill that consists of certain processes (Akyol, 2013; Arıcı & Ungan; 2017; Güneş, 2013; Karatay, 2013; Tekşan, 2013; Yıldız, Okur, Arı & Yılmaz, 2013). Other researchers have reported that the process of writing which is carried out incrementally has an important role in the development of students' written expression skills (Bruning & Horn, 2000; Graham & Sandmel, 2011; Karatay, 2013). In the writing skill that requires a process, the motivation of students becomes important in the development of their writing skills.

In the last 30 years, motivation has become an important element in the experimental and conceptual studies conducted on mother tongue and second language learning (Vaezi, 2008). Motivation has been determined as a necessary factor for successful language learning (Dörnyei, 2001) and has been elevated to a key place in successful learning (Wachob, 2006). Kellogg (2008) stated that writing skills begin to develop in childhood and continue to develop over a period of more than 20 years. It is clear that, within this long period, student motivation levels are determinants in writing skills. Student writing motivation involves the whole writing process and appears to be important in terms of transforming a writing action into a product.

Motivation is characterized by both emotional and cognitive movement, and the resulting writing process is also characterized by movement (Nelson, 2007). Harris, Graham and Mason (2006) included motivation in development of writing skills. Akyol and Aktaş (2018) stated that motivation played an important role in the development of students' writing skills. Hidi and Boscolo (2006) listed the elements that affect writing motivation as willingness, possessing sufficient information, an uncomplicated topic, receiving instant feedback and expending continuous effort during writing. Boscolo and Gelati (2007) stated that students' willingness to write generally showed tendency to decrease and disappear, and that most writing studies were seen as boring, monotonous and tiring by students. It appears there is a direct relationship between writing skills and writing motivation. Emphasizing the importance of motivation in writing, Ackerman (2006) stated that if there were no methods used to increase motivation when creating a written product, it would not be possible for the person writing (author) to show notable progress and development. Yıldız (2018) stated that, in creating motiva-

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tion among students for writing studies, teachers' enthusiasm also played a role. A study conducted on the correlation between writing motivation and writing skills by Kurudayıoğlu and Karadağ (2010) revealed that most students got bored of writing, were not willing to write and mentioned the difficulty of writing, which revealed negative approaches to writing among students. They stated that it was necessary to encourage students to make writing an enjoyable pastime and habit. Bruning and Horn (2000) stated that motivation had critical importance for the action of writing, and that it was difficult to create and maintain motivation. These studies showed that writing motivation has an important role in making the action of writing sustainable.

A review of the relevant literature determined various studies conducted on the correlation between student writing motivation and written explanation skills (Akyol & Aktaş, 2018; Canıtezer, 2014; Takımcıgil Özcan, 2014; Troia, Harbaugh, Shankland, Wolbers & Lawrence, 2013). It was found that the studies conducted in Turkey focused on the relationship between a single class level and writing motivation. The fact that there is no comprehensive research regarding the relationship between the writing motivations and written expression skills of middle-school students constitutes the basis of this study. The present study was carried out with the aim of determining the correlation between writing motivation levels (dependent variable) and written explanation skills (independent variable) among middle school students. In line with this aim, answers were sought for the following research questions:

- Is there a relationship between students' writing motivation and writing study scores?
- Is there a relationship between student gender with writing motivation and writing study scores?
- Is there a relationship between student grade level with writing motivation and writing study scores?
- Is there a relationship between student writing frequency with writing motivation and writing scores?

Method

Research Pattern

This study was carried out with the correlational research model of the quantitative research methods. Correlational studies are non-experimental research studies that make estimations to explain the relationships between variables (Christensen, Johnson & Turner, 2015). The present study investigated the writing motivation and writing evaluation scores of secondary school students and revealed the correlation between writing motivation and writing skills.

Study Group

The study group consisted of 230 students attending three different secondary schools in the fall semester of the 2018-2019 school year. For the selection of the study group, the convenient sampling method (Creswell, 2013; Cohen, Manion & Morrison, 2007; Robson; 2017) of the non-probabilistic sampling methods was used. A total of 35 students from the 5th grade (15.21%), 65 from the 6th grade (28.26%), 65 from the 7th grade (28.26%) and 65 from the 8th grade (28.26%) participated in this study. The students included in the study group were comprised of 96 boys (41.73%) and 134 girls (58.26%).

Data Collection Tools

The data collection tools used in this study were the writing motivation scale, writing evaluation form and personal information form.

The writing motivation scale developed by Yaman, Süğümlü and Demirtaş (2016) is composed of 4 sub-scales namely, self-efficacy, affective state, social acceptance, and physical state. The number of items in the writing motivation scale is 28 in total. Therefore, the maximum score receivable from this scale, which has 3-point Likert type, is 84 whereas the minimum score is 28. Four items with negative meaning were encoded inversely in the scale. The Cronbach Alpha value for the scale was .914 while it was .898 for the whole scale in this study.

The other data collection tool in the research was the Writing Evaluation Form developed by the researchers. To develop the writing evaluation form, firstly the literature was screened and an item pool containing 25 items was created. The scope validity of the writing evaluation form was evaluated by three experts in the field and five Turkish teachers. At the end of the assessment, a 17-item, 3-dimension (form, content and style) form was created. The decision was made to use 3-degree scores on the writing evaluation form for the target audience of secondary school students in the study. The items on the writing evaluation form were assessed as insufficient (1), developing (2) and sufficient (3). The reliability coefficient (Cronbach's alpha) for the writing evaluation form was determined as .89.

The personal information form which was also used in this study to collect data was prepared by the researchers to determine the gender, grade level, writing frequency variables of the study group.

Data Collection

Three secondary schools of middle socio-economic level from Altınordu district of the province of Ordu were selected for the data collection in this study. The necessary permission to collect data was obtained from the Ordu Provincial Directorate of National Education. The teachers were interviewed and were informed about the aim, content and process of the study. The data were collected within two weeks via the teachers. Before collecting the data, the students in the study group were informed about the research process and how the scale items would be read and answered. Firstly, the personal information forms were handed out to students who were gave 15 minutes to complete the forms for each class. Then the Writing Motivation Scale was completed in 40 minutes (one class hour) for every class and then writing studies were performed for 40 minutes in every class. Research data were collected from 254 students. However, 24 students did not participate in the writing study and therefore their scale data were excluded from the scope of this study. An intra-class correlation coefficient was made in order to determine the scoring reliability in the scoring of the writing studies (Landers, 2015; Shrout & Fleiss, 1979) and a high degree of reliability was found between 3 measurements. The average measure ICC was .924 with a 95% confidence interval from .905 to .940 ($F_{(229.458)}$= 13.156, p< .001).

Data Analysis

The data obtained from the writing motivation scale which was applied to determine the writing motivation levels of students and the writing evaluation form used to assess the writing tasks were statistically analyzed. The IBM SPSS 24.0 statistical program was used for data analysis. The Kolmogorov-Smirnov test was used to test whether data showed normal distribution or not, and as data were not normally distributed, nonparametric tests were used. In terms of the analysis of the data linked to subproblems, the Mann Whitney U test was used for gender and two-way comparisons, the Kruskal Wallis H test was used for grade level, writing frequency variables, the Pearson product moment correlation coefficient technique was used for correlations between writing motivation and writing scores and simple linear regression was used with the aim of determining how much writing motivation predicted writing success. To test the significance of differences, the significance level was accepted as .05.

Results

In this section, findings related to gender, grade level, writing frequency of students in the study group and correlations with writing motivation and writing evaluation scores are given.

Findings Related to Gender

The correlation of scores received for the writing motivation scale and writing evaluation form in terms of the gender of students is shown in Table 1.

Table 1. *Findings Related to Gender*

	Gender	*N*	Mean Rank	Sum of Rank	*U*	*p*
WMS (Writing Motivation Scale)	Male	96	85.73	8230.00	3574.000	.000*
	Female	134	136.83	18335.00		
	Total	230				
WEF (Writing Evaluation Form)	Male	96	86.56	8309.50	3653.500	.000*
	Female	134	136.24	18255.50		
	Total	230				

*p< .01

It can be seen from Table 1 that there is a significant difference (U= 3574.000, p= .000) in favor of the female students regarding motivation. Therefore, it can be said that motivation to write is higher among female students (Mean Rank= 136.83) than male students (Mean Rank= 85.73). Furthermore, when Table 1 is investigated, it can be seen that the students' writing evaluation scores differed in favor of female students (U=3653.500, p= .000). Accordingly, the writing evaluation scores of female students (Mean Rank= 136.24) are higher compared to male students (Mean Rank= 86.56).

Findings Related to Grade Level

The relationship between the writing motivation scores and writing evaluation form scores of the students in terms of grade level is shown in Table 2.

It can be seen form Table 2 that there is a significant difference in the writing motivation levels of students in terms of grade level (X^2= 19.692, df= 3, p< .01). However, the writing evaluation scores did not differ significantly according to grade level. With the aim of determining which groups caused the significant differences, the Kruskall Wallis H test and the two-way comparison Mann Whitney U test were performed. According to the Mann Whitney U test, there were significant differences between the 5th and 7th grade in favor of the 5th grade (U= 781.000, p= .010); between the 5th and 8th grade in favor of the 5th grade (U= 540.500, p= .000); and between the 6th and 8th grade in favor of the 6th grade (U= 1444.000, p= .002).

Table 2. *Findings Related to Grade Level*

	Grade Level	*N*	Mean Rank	*df*	X^2	*p*
WMS (Writing Motivation Scale)	5	35	147.74	*3*	*19.692*	*.000**
	6	65	127.45			
	7	65	111.02			
	8	65	90.67			
	Total	230				
WEF (Writing Evaluation Form)	5	35	122.50	*3*	*3.094*	*.377*
	6	65	123.01			
	7	65	115.51			
	8	65	104.22			
	Total	230				

*p< .01

Findings Related to The Frequency of Writing

The correlation of scores received for the writing motivation scale and writing evaluation form in terms of the writing frequency of students is shown in Table 3.

From Table 3, it can be seen that the writing motivation of students differed significantly according to the frequency of writing outside of school (X^2= 59.193, df= 3, p< .01). Additionally, there was a significant difference in the writing evaluation scores according to non-school writing frequency (X^2= 51.874, df= 3, p< .01). With the aim of determining which groups caused significant differences, the Kruskal Wallis H test and the two-way comparison Mann Whitney U test were performed. According to the Mann Whitney U test used to determine which groups caused the significant differences in writing motivation in terms of non-school writing frequency, there were significant differences between those who wrote every day and those who wrote once a week in favor of those who wrote every day (U=2485.000, p= .043); between those who wrote every day and those who wrote once a month in favor of those who wrote every day (U= 609.000, p= .000); between those who wrote every day and those who wrote less often in favor of those who wrote every day (U= 342.500, p= .000); between those who wrote once a week and those who wrote once a month in favor of those who wrote once a week (U= 301.500, p= .000); and between those who wrote once a week and those who wrote less often in favor of those who wrote once a week (U= 188.000, p= .000).

Table 3. *Findings Related to the Frequency of Writing*

	Writing frequency	*N*	Mean Rank	*df*	X^2	*p*
WMS (Writing Motivation Scale)	Every day	132	138.47	3	59.193	.000*
	Once per week	47	117.46			
	Once per month	29	57.22			
	Less often	22	50.34			
	Total	230				
WEF (Writing Evaluation Form)	Every day	132	137.89	3	51.874	.000*
	Once per week	47	113.79			
	Once per month	29	61.84			
	Less often	22	55.52			
	Total	230				

*p< .01

According to the Mann Whitney U test used to determine which non-school writing frequency caused significant differences in writing evaluation scores, there were significant differences identified between those who wrote every day and those who wrote once a week in favor of those who wrote every day (U= 2373.500, p= .017); between those who wrote every day and those who wrote once a month in favor of those who wrote every day (U= 705.000, p= .000); between those who wrote every day and those who wrote less often in favor of those who wrote every day (U= 433.500, p= .000); between those who wrote once and week and those who wrote once a month in favor of those who wrote once a week (U= 333.500, p= .000); and between those who wrote once a week and those who wrote less often in favor of those who wrote once a week (U= 217.000, p= .000).

Findings Related to Correlation of Writing Motivation and Writing Scores

The correlation between the writing motivation and writing scores of the students is shown in Table 4.

Table 4. *Correlation Result for Relationship between Writing Motivation and Writing Grade Scores*

Variables	1	2
WMS (Writing Motivation Scale)	1	
WEF (Writing Evaluation Form)	.68*	1
Mean	65.39	38.48
SD	9.96	6.24

*p< .01. N= 230; *SD*: Standard Deviations

It can be seen from Table 4 that there is a positive significant correlation between the writing motivation and writing scores of the students (r= .68, p< .01). Accordingly, as the writing motivation of the students' increases, writing evaluation scores also increase.

Findings Related to Regression Analysis

The decision was made to apply simple linear regression analysis with the aim of determining the extent that writing success was predicted by writing motivation. Before beginning the regression analysis, it is necessary to ensure that a range of preconditions are met. Firstly, two-way correlations between the variables were investigated and it was made sure that multi-collinearity did not exist. With this aim, the Durbin-Watson value was investigated in the auto-correlation situation and it was concluded that the value obtained (1.72) was within normal limits (Field, 2013). Secondly, the tolerance value of the variance ratio that could not be explained by the independent variable (1-R^2) and the variance inflation factor (VIF) were investigated. As the tolerance value (1-R^2= 1.00) was larger than .20 and the variance inflation factor (VIF= 1.0) was lower than 10, it was concluded there was no multicollinearity problem (Field, 2013).

After ensuring the necessary preconditions, the simple linear regression analysis results determined that writing motivation explained 46% of the total variance of writing success ($F_{(1, 228)}$= 199.42, p< .001). The positive contribution of writing motivation to the regression model was determined to be significant ($ß$= .68, p< .001). The prediction of writing success is shown in Table 5.

Table 5. *Predictors of Writing Success*

	B	*SE*	*ß*	*t*	*p*
Fixed	10.49	2.00		5.23	.000
WM	.42	.03	.68	14.12	.000

R^2= .46, ΔR^2= .46, p< .001, WM: Writing Motivation

Discussion and Conclusion

This study aimed to determine the correlation between the writing motivation levels and writing skills of students. In addition, the study investigated the writing motivation levels and writing skills of students in terms of the variables of gender, grade level, writing frequency. Based on the findings of this study, the following results were obtained:

Students with high writing motivation scores had high writing evaluation scores. In a study conducted on 4th grade primary school students, Akyol and Aktaş (2018) reported that students with high writing motivation had higher story writing scores. In a study conducted on 617 students from 4th grade to 10th grade level (apart from 8th grade), Troia, Harbaugh, Shankland, Wolbers and Lawrence (2013) concluded that students with high writing motivation had high writing scores. A study by Hidi and Boscolo (2006) found that students with higher writing motivation and more willingness to do writing tasks had higher writing performance than students with low motivation and less desire to write. In a study conducted on fourth-grade students in primary school, Takımcıgil Özcan (2014) concluded that students with high writing motivation had higher story writing skills. In her study on 8th grade students, Canıtezer (2014) concluded that there was a positive relationship between the writing motivation and the written expression skills of students and that the students with high writing motivation were successful in written expression skills. A study by Bruning and Horn (2000) concluded that motivation was a significant determinant for writing. These results support the results of the present study. In addition, Guay, Ratelle and Chanal (2008) stated that certain factors and motivation positively affect the academic skill levels of individuals.

When the writing motivation scores of the students were examined according to the gender variable, it was determined that female students had higher writing motivation and writing evaluation scores compared to male students. Thus it can be said that female students are more successful in terms of writing motivation and writing studies than male students. The study by Troia, Harbaugh, Shankland, Wolbers and Lawrence (2013) concluded that female students had better story-telling skills than male students. Takımcıgil Özcan (2014) found that female students had higher writing motivation compared to male students. The study by Akyol and Aktaş (2018) concluded that female students had higher motivation than male students. These results support the results of the present study. Canıtezer (2014) concluded that the writing motivation and written expression skills of female student were higher compared to male students.

When the writing motivation scores of students were examined according to the grade level variable, it was determined that the 5th grade students had higher motivation scores than students in the 6th, 7th and 8th grades. In addition, it was concluded that the 6th grade students had higher writing motivation scores than the 7th and 8th grade students. The grade level with lowest writing motivation scores were determined as the 8th grade. It can be said that as the grade level increases, writing motivation scores decrease. There was no correlation determined between writing evaluation scores and grade level. As was in this study, the study by Troia, Harbaugh, Shankland, Wolbers and Lawrence (2013) concluded that writing motivation was not affected by grade level. They also concluded that writing scores increased with grade level.

When the writing motivation scores of the students were examined in terms of writing frequency, it was concluded that the writing frequency of the students increased with the increase in motivation scores. The writing motivation scores of the students who wrote every day were higher than those who wrote once a week, once a month and less often. Oldfather and Shanahan (2007) stated that writing motivation increases with the increase in the experiences of students in developing their ideas. The writing frequency variable in this study expresses the writing experiences of the students and the fact that the students with high writing frequency also have high writing motivation is an important result of this study. When the writing evaluation scores of the students were examined in terms of writing frequency, it was determined that, as the writing frequency increased, the writing evaluation scores also increased. The students who wrote every day had higher writing evaluation scores compared to those who wrote once a week, once a month or less often. The writing motivation and writing scores of the students with high writing frequency were found to be higher compared to those with low writing frequency.

Study Limitations and Directions for Future Studies

This study was limited to 230 students (5th, 6th, 7th and 8th grades) studying at secondary school, theoretical and practical studies for the concept of motivation, Turkish Language Teaching Program (2018) and the fall semester of the 2018-2019 school year. This study aimed to determine the relationship between writing motivation and writing skills and concluded that writing motivation affects writing success. Based on the outcomes of this study, the following recommendations have been put forward:

1. Establishing students' writing motivation in writing teaching,

2. Conducting research in writing teaching by taking into account the students' writing motivation,

3. Conducting studies that will facilitate writing motivation in students.

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Appendix 1. Writing Evaluation Form

Field	Substance	1 (Not Sufficient)	2 (Must Improve)	3 (Sufficient)
Content	Subject	Failed to write a paper on a topic	Partially wrote a paper on a topic	wrote a paper on a topic
	Purpose	The purpose of the paper is missing	The purpose of the paper is partially clear	The purpose of the paper is clear
	Main Idea	Failed to write the paper around a main idea	Partially wrote the paper around a main idea	Wrote the paper around a main idea
	Secondary Idea	Failed to write the paper with secondary ideas	Partially wrote the paper with secondary ideas	Wrote the paper with secondary ideas
	Subject Integrity	There is no subject integrity in the paper	There is a partial subject integrity in the paper	There is a subject integrity in the paper
	Content Integrity	There is no content integrity in the paper	There is a partial content integrity in the paper	There is a content integrity in the paper
	Consistency	Paper is not consistent	Paper is partially consistent	Paper is consistent
	Title	There is no title in the paper	Title and the content of the paper are not compatible	Title and the content of the paper are compatible
	Writing Parts (Introduction, Body, Conclusion)	Paper was not broken down into parts	There is a partial breakdown of parts in the paper	The paper was properly broken down to parts: Introduction, Body and Conclusion
Structure	Spelling rules	Did not heed spelling rules in the paper	Partially used spelling rules in the paper	There is a proper use of the spelling rules in the paper
	Punctuation rules	Did not heed punctuation rules in the paper	Partially used punctuation rules in the paper	There is a proper use of the punctuation rules in the paper
	Readableness (Handwriting)	Paper is not readable	Paper is partially readable	Paper is readable
	Paper Layout	Layout is neglected	Layout is partially neglected	Layout is appropriate
Wording	Expression	The paper is not written in a clear and understandable manner	The paper is partially clear and understandable	The paper is clear and understandable
	Compatibility with the Target Audience	The paper is not compatible with the target audience	The paper is partially compatible with the target audience	The paper is compatible with the target audience
	Emotion and Thought	Emotions and thoughts are not expressed in the writing	Emotions and thoughts are partially expressed in the writing	Emotions and thoughts are expressed in the writing
	Originality	There is no original expression in the paper	There is partial original expression in the paper	There is original expression in the paper

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Examining Teacher Mathematics-related Beliefs and Problem-solving Knowledge for Teaching: Evidence from Indonesian Primary and Secondary Teachers

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Abstract

This paper reports a two-year research project studying Indonesian primary and secondary teachers' mathematics-related beliefs (MrB) and mathematical problem-solving knowledge for teaching (MPSKT). In the first year, a quantitative study involving 80 primary teachers, 70 lower secondary school, and 55 upper secondary schools from four districts in East Java province, Indonesia was carried out to examine whether there is a difference between the MrB and the MPSKT among them. In the second year, a multiple case study involving ten primary teachers and 13 lower secondary teachers was conducted to understand their MrB and MPSKT through some particular issues related to three domains of MrB: nature of mathematics, mathematics teaching, mathematics learning. Results indicate that there is no significant difference of MrB between primary and secondary teachers, while there is a significant difference between the MPSKT of primary teachers and secondary teacher. Findings also suggest that inconsistencies not only occur between the three domains of MrB but also occurs between particular issues discussed within one domain. Also, this study highlights that teacher beliefs about nature of mathematics were mainly influenced by teachers' experience when learning mathematics during their schooling experience while teacher beliefs about teaching and learning were mainly influenced by the demand of current reform of mathematics curriculum.

Keywords: Mathematics-Related Beliefs, Problem-Solving Knowledge For Teaching, Instrumentalist, Platonist, Problem-Solving, Indonesian Teacher

Introduction

Knowledge and beliefs of teachers are still becoming areas of considerable current research activity in mathematics education (Beswick, 2012; Liljedahl, 2010; Xenofontos, 2018). Across nations, teacher beliefs have been assessed to understand the influence of cultural aspect toward teachers' view and performance of teaching practice (see, e.g. Andrews & Hatch, 2000; Cai & Wang, 2010; Wang & Cai, 2007; Xenofontos, 2018). Meanwhile, teacher mathematical knowledge have been assessed through international surveys with a significant number of samples such as TEDS-M (Teacher Education and Development Study in Mathematics) (Tatto et al., 2013) to compare the teacher performance on mathematical knowledge for teaching and single-nation studies (e.g. Ekawati et al, 2015; Siswono et al, 2016; 2017) with a smaller number of samples through qualitative or quantitative studies.

In Indonesia, teacher beliefs and knowledge have begun to get attention from educational researchers, particularly to understand the initial assessments as resources for upgrading the quality of Indonesian mathematics teachers (Ekawati et al, 2015; Purnomo et al., 2016; Purnomo, 2017; Siswono et al., 2016). This effort is to answer the challenge of the significant curricular reform for all school levels for primary, junior high school, and senior high school which is currently undergoing since the year 2013. Such a reform, as found in the previous curriculum, keep giving focus on improving students' problem-solving (MoE, 2016). However, the educational researchers through their national single-studies reported teachers' weaknesses on problem-solving content and pedagogical knowledge (see, e.g. Siswono et al, 2016), the knowledge which direct teachers hold problem-solving instruction (Chapman, 2015). Also, several reports reveal teachers' inconsistent beliefs toward teachers' teaching practice (Purnomo et al., 2016; Siswono et al., 2017; Siswono et al., 2018a), and teachers' traditional beliefs about the nature of mathematics which influence more dominantly than the other domains of beliefs against instructional practices (Purnomo, 2017). Thus, the reform of curriculum needs changing teachers' beliefs because teachers behavior regarding their use of new resources mandated by the curriculum, as Handal and Herrington (2003) argued, will be cosmetic, which means that the behaviors do not indicate the manifestation of the expected principles of the curriculum reform.

Teacher beliefs and knowledge are two distinct concepts the differences around conviction and consensuality (Thompson, 1992). First, beliefs can be held with varying degrees of confidence, while general knowledge is not thought of in this way. For example, while someone might say that he believes in something strongly, he will be less likely to talk about knowing facts actively. Second, beliefs are not consensual, while knowledge is consensual. That is, someone is generally aware that other people may believe differently and that their thought is indisputable, while concerning knowledge, people find general agreement about procedures to evaluate and assess their validity.

Despite these two are different, there is a relationship between teacher knowledge and beliefs regarding mathematics instruction. Along with teacher mathematical knowledge, teacher mathematics-related beliefs such as beliefs about nature of mathematics, mathematics teaching, and mathematics learning also become variables that play a role in guiding that knowledge to create meaningful mathematics learning (Purnomo, 2017). Teacher mathematics-related

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beliefs have been researched to have strong interactions with knowledge in shaping teacher teaching practices with varying degrees given on certain types of knowledge or beliefs in different situations (Bray, 2011). While teacher knowledge appeared to drive the quality of teachers' responses to student performances in class discussions, teacher beliefs seemed most related to how teachers structured class discussions (Bray, 2011). Concerning how beliefs and knowledge interact, Ren and Smith (2017) suggest the potential role of teachers' mathematical knowledge for teaching in improving teachers' mathematical beliefs. Such an interaction is in line with the finding of Siswono et al. (2017) through a case study reporting that teachers' insufficient knowledge about problem-solving is consistent with teachers' traditional beliefs.

Regarding teacher beliefs, much research gives attention to the role of cultural and geographical impact on teachers' mathematics-related beliefs (see, e.g. Correa et al., 2008; Wang & Cai, 2007; Xie & Cai, 2018), and gender impact on teacher beliefs (e.g. Spangenberg & Myburgh, 2017). However, only a relatively few reported findings which figure out how particular school grade level inform the unique characteristics of teachers' beliefs compared to another different grade level of teaching. One of such few discussion was reported by Purnomo et al. (2018) through their study involving Indonesian teachers finding that there is no significant difference on beliefs held by teachers with different grade level taught in the same scope of school grade level, i.e. primary school. Beyond this scope, this present study aims to examine how teachers at different school grade, i.e. primary, lower secondary, and upper secondary, as it goes in Indonesian educational system, differ regarding their mathematics-related beliefs. This is to follow the recommendation from Xenofontos (2018) suggesting to examine further the extent to which teachers' beliefs are similar or different across school levels, within the same cultural context and educational system. Regarding teacher knowledge, in the same school grade level, for example, the study of Ng (2011) found that there were no significant differences in the teacher knowledge scores between teachers who had taught lower primary grades and those who had taught upper primary classes. However, they do not analyze the comparison between teachers in primary school and secondary school simultaneously.

This study aims to reveal whether there is a relation between MrB and MPSKT of teachers across school level of teaching grade as well as analyze particular issues within domains of MrB and components of MPSKT held by the teachers regarding Indonesian context. In detail, the aims are to (1) examine whether there are any significant differences between the MrB and the MPSKT of primary teachers, lower-secondary school, and upper-secondary school teachers, as well as (2) analyze their beliefs about the nature of mathematics, mathematics teaching, and mathematics learning, and the problem-solving content knowledge and problem-solving pedagogical knowledge.

Theoretical Framework

Mathematics-Related Beliefs: Nature of Mathematics, Mathematics Teaching, and Learning

There is no standard taxonomy used to define the conceptions of the nature of mathematics although relevant literature is quite numerous. Cai and Wang (2009) argued that teachers' conception of the nature of mathematics could be viewed as teacher's conscious or subconscious beliefs, meanings, rules, concepts, mental images, and preferences regarding the discipline of mathematics. In this study, we used the categorization of Ernest (1989) for the nature of mathematics. The instrumentalists pay more attention to the functions of mathematics knowledge in the external world (functional perspectives), which is a collection of unrelated facts, rules, and skills. Platonists emphasize the complexity of the internal structure of the knowledge itself (structural perspectives), which is seen as a static and unified body of knowledge, while problem-solving view emphasizes the dynamic and creative properties of mathematics as a human invention.

Ernest (1989) accentuates that teachers' view of the nature of mathematics is the most essential because it affects the other two domains of mathematics-related beliefs: mathematics teaching and learning. Therefore, researching about teacher view of nature mathematics, scholars often also necessary to study teachers' view of mathematics teaching and mathematics learning (e.g. Siswono et al., 2016; 2017; Xenofontos, 2018). Thus, this paper concern on examining primary and secondary teachers' view of those three beliefs.

Mathematics teaching beliefs, as Thompson (1992) suggested, include teacher role, students' role, desirable instructional approaches and emphases, appropriate classroom activities, legal, mathematical procedures, and acceptable outcomes of instruction. Furthermore, at least there are three distinctive views: learner-focused, content-focused with an emphasis on performance, content-focused with an emphasis on understanding. Essentially, some researchers also correspond to each of Thompson's categories of views with 'teacher-centered' teaching beliefs and 'student-centered teaching beliefs' (Correa et al., 2008). While 'teacher-centered' view corresponds to 'content-focused' view with an emphasis on performance, the idea of 'student-centered' teaching view is aligned with 'learner-focused' view. Regarding mathematics, it includes the process of learning mathematics, what behaviors and mental activities are involved on the part of the learner, and what constitutes appropriate and prototypical learning activities (Ernest, 1989). Beswick (2005) has summarised this conception into a table which compares teacher beliefs about mathematics (Ernest, 1989), mathematics learning (Ernest, 1989) and mathematics teaching (Van Zoest et al., 1994). She argues that there are three groups of hierarchical view of those three beliefs which is considered theoretically consistent each other, i.e. (1) Instrumentalist – skill mastery – content focused with an emphasis on performance, (2) Platonist – active construction of understanding – content focused with an emphasis on understanding, and (3) problem-solving – learner focussed – autonomous exploration of own interest.

Mathematics Teachers' Knowledge for Teaching Problem-Solving

There is a consensus that teachers' knowledge about mathematical problem-solving is not merely about having proficiency in solving a mathematical problem. Instead, it also covers knowledge about how to become a good problem-solvers as well as how to help students become better problem solvers. In this sense, Chapman (2015) has proposed the so-called 'mathematical problem-solving knowledge for teaching (MPSKT)' that can guide teachers to teach problem-solving. In general, MPSKT consist of (1) problem-solving content knowledge (knowledge of problem, problem-solving, and problem posing), (2) pedagogical problem-solving (knowledge of students as problem solvers and instructional practice for problem-solving), and (3) knowledge of affective factors and beliefs (nature and impact of productive and unproductive factors on learning and teaching problem-solving).

This paper primarily concerns MPSKT by Chapman (2015) although not all the components were examined to teachers. This is due to the complex issues which are interde-

pendent within MPSKT. Thus, we only highlight some elements of the first two components of MPSKT, covering, for examples, the nature of the mathematical problem and problem-solving, problem-solving process and strategies, and organizing problem-solving instruction.

Method

The Research Design

This project employs a mixed method with sequential design, in which data that are collected and examined in one stage inform the data collected in the next phase (Ary et al., 2018). In this study, the authors draw on the interpretation of the findings from a quantitative study, followed by qualitative research through a collective case study methodology. In particular, the quantitative research was carried out to describe the results of the aim no 1, while the qualitative research was carried out to answer the describe the results of the aim no 2. All the answers were then reported in two separate sets (qualitative and quantitative) of coherent wholes.

First-Year Research Design

The quantitative research was employed by collecting data on teachers' responses on MrB and MPSKT through a set of questionnaire. The items used in such questionnaire were the same as those in the questionnaire we used in our previous single-study involving only secondary teachers as study samples (see Siswono et al., 2016). The questionnaire consisted of 18 multiple choices questions (3 MrB items and 15 MPSKT items). Each item provided 4 to 17 choices. Some of those questions had a large number of choices because of a need to cover as many as possibilities of teacher's responses. For instance, the question item for MrB related to mathematics learning: "In my opinion, the best way students should learn mathematics are..." has 12 choices consisting 4 options indicating 'skill mastery' view (score 1), 4 options indicating 'active construction of understanding' view (score 2), and 4 items indicating 'autonomous exploration of own interest' view (score 3). Thus, the teacher could choose more than one options. Meanwhile, MPSKT items were derived from Chapman's category described in table 1. The groups are (a) problem solving content knowledge: meaning of problem (1 item), types of problem (1 item), problem solving as instruction (1 item), problem solving steps (3 items), problem-solving strategies (2 items), and (b) pedagogical problem solving knowledge: instructional practice of problem solving (3 items), and designing problem solving task (3 items).

The score varies to show the level of understanding from 1.00 (do not understand), to 3.00 (fully understand), while the other scores vary to show the level of beliefs on mathematical problem solving from 1.00 (instrumentalist view) to 3.00 (problem-solving view). The score is given to each participant on each question based on the following formula (Siswono et al.,2016).

$$\text{Score} = \frac{\text{obtained total score}}{\text{number of selected options}}$$

In detail, we have adopted a guideline to categorize these levels as shown in table 1 from Siswono et al. (2016).

To confirm the validity of the questionnaire, all the items tested are significantly valid, with the coefficient validity of each of the items is interpreted as at least medium (.253< r_{xy} < .511), and the reliability coefficient (.60) as medium as well. Data were then analyzed by employing one-way ANOVA which were used to investigate differences of MrB and MPSKT among teachers in terms of the grade level of teaching. The assumptions were conducted in terms of normality and homogeneity of data before doing such a one-way ANOVA test.

Table 1. *Scoring category level of teachers' understanding and beliefs (Siswono et al., 2016)*

Score (S)	Level of MrB	Level of understanding MPSKT
$1.00 \le S \le 1.67$	as instrumentalist view/skill mastery/ content-performance	not understand (NU)
$1.67 \le S \le 2.33$	as platonist view/ active construction of understanding/ content-understanding	partially understand (PU)
$2.33 < S \le 3.00$	as problem-solving view/learner own interest/learner focused	fully understand (FU)

Second-Year Research Design

A multiple case study was undertaken in the qualitative research. A simultaneous cross-case analysis approach was conducted to illuminate patterns across cases and increase the potential for generalizing beyond particular cases (Yin, 2003). The cases were the MrB and the MPSKT of all teacher participants. Such an approach followed Stake's (2005) opinion arguing that in collective case studies, cases are chosen because it is believed that understanding them will lead to better understanding, perhaps better theorizing about a still more extensive collection of cases. Using a constant comparative method to focus data collection and analysis (Glaser, 2017), interpretive case studies on each of primary and secondary teacher participants were developed using data collected through a semi-structured interview about MrB and MPSKT.

Regarding MrB interview, the teacher participants were provided with a set of incomplete statements each of which has three options in which they were asked to select only one as the best options representing their beliefs related to the proposed issue. For example, the incomplete statement, "In motivating students to learn mathematics, I prefer to..." has three options: (1) give some rewards since it is an excellent strategy to make students keep on doing mathematics tasks, (2) provide some rewards if only students work actively in what I asked them to do, and (3) give challenging and interesting mathematical tasks, regardless of whether they will get any rewards or not. Options (1), (2), and (3) respectively represent the category of beliefs: content-performance, content-understanding, and learner focused. Once the teacher participants selected one of the options, they were prompted to give a reason why selected those options and how they compare their options chosen with two other unselected options. Overall, Table 2 shows some particular issues drawing on Mr-B, some of which were adapted from Cai and Wang (2009) and derived from Beswick's summary (2005) and MPSKT, which were derived from Chapman's (2015) categories of MPSKT.

The MPSKT interview items, in particular, encouraged them to answer direct questions posed by the interviewers (the authors themselves). For example, in relation to the issue about nature of mathematical problems, the teacher participants were provided with three mathematical questions having different concern on characteristics of mathematical problem such as has no readily available procedure for finding the solution as well as challenges and attracts students to work out the questions, and by responding and arguing whether each of them is a problem for their students.

Table 2. *Issues related to MrB and MPSKT discussed with teacher participants*

Domain of MrB	Mr-B issues	Categories of MPSKT	MPSKT issues
Nature of mathematics	• Definition of mathematics • mathematical skills need to be addressed by someone, • the relationship between mathematics and real-life problem,	Problem-solving content knowledge	• nature of mathematical problem • types of mathematical problem • problem-solving process • problem-solving strategies • nature of problem-solving • problem-posing
Mathematics teaching	•how to improve problem-solving skill, •the use of mathematical formula, •the use of a calculator in solving the problem, •students should learn about various strategies,	problem-solving pedagogical knowledge	• knowledge of students' difficulties on problem-solving • knowledge of teaching problem-solving task
Mathematics learning	•the role of the teacher in helping students to solve the task, • the precise time to introduce an applied problem-solving task, • sources of problems used in instruction, • how to clarify students' misunderstanding on a problem-solving-based instruction, • the best way of teaching a problem-solving task • the dynamic characteristics of strategies and solutions in solving a problem-solving task	affective factors and beliefs	---

Participants

Overall, this study took place at four districts: Surabaya, Mojokerto, Sidoarjo, and Gresik in East Java Province, Indonesia where all the participants were recruited from those four districts as well. At the first-year research, this project involved 80 primary teachers, 70 lower secondary school, and 55 upper secondary schools. All those teachers were from schools in urban and rural areas, having teaching experiences from 5 to 40 years, all of which represent the various background of samples.

Meanwhile, in the second year, this project was conducted by recruiting ten primary teachers and 13 lower secondary teachers. These numbers were chosen since we no longer got relatively new issues emerged from the teachers' responds at those number of interviews. This principle followed the opinion of Fusch and Ness (2015) arguing that the number of meetings needed to reach data saturation could be based on the extent to which the number of interviews decided by researchers can obtain additional new information and makes further coding is no longer feasible. The teacher participants from upper-secondary school were no longer involved in the second-year research since the recommendation of the results of the first-year research (presented in the results section) finding that there is no any significant differences between MrB and MPSKT between the two. Therefore, they could be categorized into one group of teachers. Thus, we selected lower-secondary teachers as representative of this group.

Furthermore, the number of teachers in the second-year research is smaller than that in the first-year research due to the concern of employing a qualitative approach which in this case need not large samples. Besides, the teachers involved in the first-year research differ from those involved in the second-year research. Table 3 presents biographical information about the participants completed with their pseudonyms, gender (15 female, 8 male) and years of teaching experiences (M= 17.9, SD= 11.3) indicating the various background of samples.

Table 3. *The participants of the second-year research*

Primary teachers			Secondary teachers		
Pseudonym	Gender	Years of teaching experience	Pseudonym	Gender	Years of teaching experience
P1	female	10	S1	male	35
P2	male	30	S2	female	40
P3	female	18	S3	male	34
P4	male	5	S4	male	12
P5	female	8	S5	male	7
P6	female	12	S6	female	21
P7	female	9	S7	female	6
P8	female	12	S8	female	8
P9	female	9	S9	male	32
P10	male	36	S10	female	14
			S11	female	27
			S12	female	12
			S13	female	16

The interview was conducted individually, lasted on average 45-60 minutes for MrB and 30-45 minutes for MPSKT. Data analysis was carried out by firstly reducing data, dis-

playing data, and finally drawing conclusions and verification (Miles & Huberman, 1994). The conclusion was sought to understand the comparison of the MrB and MPSKT between primary and secondary teachers, particularly in the context of Indonesia. The data derived from the second-year research were used in this paper to illustrate the quantitative findings from the first-year research as well as to provide a general overview of the orientations of groups of teachers regarding MrB and MPSKT.

Results

Teachers' MrB and MPSKT: Quantitative Results

Prior to ANOVA tests, normality tests were performed first to determine whether the sample data taken has followed the distribution of normal distribution. The normality test is given in table 4.

The table indicates that all the data collected from teachers' MrB and MPSKT were normally distributed based on Kolmogorov-Smirnov test as indicated by the value of *p* which is all more than .05. Therefore, the data were examined in the Levene statistic test to investigate the homogeneity of variances.

Table 5 shows the result of Levene statistic which examines whether the samples of data were taken from the population having the same variances. The result indicates that both the significances p for the data of MPSKT and MrB are more than .05, which means they meet the homogeneity of variances. Therefore, the statistical test could be continued with the ANOVA test.

The ANOVA test shown in table 6 indicates that there is a statistically significant difference among the MPSKT of primary teachers, lower-secondary teachers, and upper-secondary teachers (F= 11.279, p= .00< .05), while there is not a statistically significant difference among the MrB of primary teachers, lower-secondary teachers, and upper-secondary teachers (F= 1.527, p= .22> .05). Tukey's HSD test was examined to identify means that are significantly different from each other; This is presented in the table as follows.

When table 7 is examined, it can be seen that the MPSKT of primary teachers and lower-secondary teachers is significantly different (p= .00< .05). Also, the MPSKT of primary teachers and upper-secondary teachers was significantly different (p= .002< .05). Meanwhile, the other pair of the group, lower-secondary teachers and upper-second-

Table 4. *Test of Descriptive Statistic and Normality of MrB and MPSKT*

	School Grade	Mean	Interpretation	*SD*	Kolmogorov-Smirnov		
					Statistic	*df*	*p*
MrB	Primary teacher	2.24	Platonist	.442	0.085	80	.200
	Lower-secondary teacher	2.13	Platonist	.413	0.080	70	.200
	Upper-secondary teacher	2.27	Platonist	.335	0.106	55	.184
MPSKT	Primary teacher	2.30	Partially understand	.195	0.630	80	.200
	Lower-secondary teacher	2.49	Fully understand	.187	0.055	70	.200
	Upper-secondary teacher	2.46	Fully understand	.167	0.067	55	.200

Table 5. *Test of Homogeneity of Variances*

	Levene Statistic	*df1*	*df2*	*p*
MrB	2.464	2	202	.088
MPSKT	1.343	2	202	.263

Table 6. *ANOVA results*

		Sum of Squares	*df*	Mean Square	*F*	*p*
MrB	Between Groups	0.525	2	0.262	1.527	.220
	Within Groups	34.713	202	0.172		
	Total	35.238	204			
MPSKT	Between Groups	0.808	2	0.404	11.729	.000
	Within Groups	6.956	202	0.034		
	Total	7.763	204			

Table 7. *Multiple Comparisons: Tukey HSD*

Dependent Variable	School grade	School grade	*Mean Difference*	Std. Error	*p*
MrB	Primary	Lower-secondary	*0.09048*	0.06785	*.378*
		Upper-secondary	*-0.03156*	0.07261	*.901*
	Lower-secondary	Primary	*-0.09048*	0.06785	*.378*
		Upper-secondary	*-0.12204*	0.07470	*.234*
	Upper-secondary	Primary	*0.03156*	0.07261	*.901*
		Lower-secondary	*0.12204*	0.07470	*.234*
MPSKT	Primary	Lower-secondary	*-0.13909**	0.03037	*.000*
		Upper-secondary	*-0.11101**	0.03250	*.002*
	Lower-secondary	Primary	*0.13909**	0.03037	*.000*
		Upper-secondary	*0.02808*	0.03344	*.679*
	Upper-secondary	Primary	*0.11101**	0.03250	*.002*
		Lower-secondary	*-0.02808*	0.03344	*.679*

*. The mean difference is significant at the .05 level.

ary teachers show a not significantly different regarding MPSKT (p= .679> .05). This indicates that the MrB among primary, and secondary teachers are relatively same. Furthermore, since a significant difference of MPSKT between primary teachers and secondary teachers (both lower and upper) was found, the score of each group can be compared through the descriptive results, presented in table 4. It was found that the mean score of MPSKT of lower-secondary teachers (M= 2.49, SD= .187) is relatively higher when compared with that of primary teachers (M= 2.30, SD= .195). Likewise, the mean score of MPSKT of upper-secondary teachers is relatively higher when compared with that of primary teachers (M= 2.46, SD= .167). This results could indicate that secondary teachers had better MPSKT than primary teachers.

The results of the quantitative research as described above become the basis of selecting participants in the second-year research. Thus, we selected the only representative from lower-secondary school and primary teachers.

Teachers' MrB: Qualitative Results

Beliefs about mathematics

Table 8 summarises primary and secondary teachers' belief about mathematics. The teachers' views are presented from three cases: (1) mathematical skills need to be addressed by someone, (2) relationship between mathematics and real-life, and (3) definition of mathematics.

This is not to generalize which group is more 'problem-solving'. Instead, it tried to zoom in how each group of teachers gives their views on particular issues in domains of mathematics-related beliefs for each of Instrumentalist view, Platonist view, and problem-solving view. The following describes according to cases related to each domain of mathematics-related beliefs.

Definition of mathematics

Platonist beliefs about what mathematics is were expressed by most of the primary (6 teachers) and secondary teachers (10 teachers). A platonist view such as the statement that mathematics is discovered can be observed from S2. "I think the objects of mathematics are created spread throughout this world. The problem is that not all the objects have been found by humans. That is why people only search those objects, which in the future, I believe, there will be many more mathematical objects found." Similarly, P1 asserted this view by expressing their teaching topic. He says, "I do not find anything different from what I learned in mathematics, from the past to the present and even the future. The types of triangles, for example, always consist of, say, isosceles triangle, equilateral triangle, right triangle, and scalene triangle. And, the product of two integers such as negative times always negative positive, remains the same ...". He finally concludes, "The object of mathematics will be remaining the same. The only thing that can change is only about the strategies to solve problem-related to mathematics."

Meanwhile, Instrumentalist beliefs about mathematics are revealed by two primary teachers and two secondary teachers. Generally, they agree that mathematics is a set of rules, procedures, skills that are used to solve any real-life problem, which is line with Ernest's (1989) view that it accentuate the functions of mathematical knowledge on its external world. In this regard, P9 says, "Mathematics is a queen of science, meaning that it is used to solve any problems across disciplines, like physics, chemistry, even social science. That is why when someone is an expert in calculating, executing algebraic or geometrical procedures, statistical skills, etc., he/she will learn other related disciplines better." The problem-solving view, on the other hand, is expressed by only two primary and 1 secondary teacher. This viewpoint out that mathematics is a discipline which emphasizes the development of thinking skills, such as reasoning, critical thinking, and creative thinking. S12, for instance, argues that "The essential thing you need to learn from mathematics is not only about calculating numbers or carrying out some mathematical operations, but also about the skills of thinking critically and creatively or recognizing the pattern of phenomena. Even when you want to decide something, unconsciously, you apply your mathematical thinking."

Interestingly, some teachers seemed to have two beliefs simultaneously. For example, P1 not only agree that mathematics is a static body of knowledge that exists on its own but also agree that it is also a science of understanding pattern represented by symbols. He said, "It needs logic to do with mathematics. However, from year to year, mathematics will not change. The symbols of mathematical operation such as +, - x, and : as well as the results of any mathematical operation of particular numbers will be remaining same." Another point of interest is that both primary and secondary teachers espoused their beliefs by exemplifying their evidence from their daily teaching activities. For example, when P10 expressed her Platonist view, she asserted, "From the first year I taught, I never found any change from the results of mathematical operation."

Mathematical skills need to be addressed by learners

An instrumentalist view emphasizes that skills of calculating and carrying out mathematical procedures are the most important skill an individual should have. S1 gives his view. "People should be able to have a good skill in calculating first before applying a various mathematical formula. Without this skill, they would not be able to think creatively or even critically." Meanwhile, a Platonist view is revealed, for example, by S2. He says, "Understanding various branches of mathematics is important since it will be useful for those who want to learn mathematics seriously, or for those who want to be a mathematician. However, the need for having creative thinking, although it is learned in mathematics, is not the primary focus of learning mathematics." In contrast, a problem-solving view like

Table 8. *Primary and secondary teachers' views about the nature of mathematics*

Cases	Primary			Secondary		
	Instrumentalist	Platonist	Problem-solving	Instrumentalist	Platonist	Problem-solving
Definition of mathematics	P5, P9	P1, P3, P4, P10, P6, P7	P2, P8	S1, S6	S2, S3, S5, S7, S8, S9, S10, S11, S13, S4	S12
Mathematical skills need to be addressed by someone	P5, P9, P10	P3	P1, P2, P4, P6, P7, P8	S1, S3, S6, S8	S2, S4, S9, S13	S5, S7, S10, S11, S12
The relationship between mathematics and real-life	P4, P6, P10	P3, P5, P9	P1, P2, P7, P8	S1	S2, S5, S6, S7, S8, S9, S10, S13	S3, S4, S11, S12

expressed by P7 shows that calculating skills and applying the mathematical formula in real life problem mathematics is more than calculating. P7 adds, "It needs understanding thinking skills and catching various patterns of phenomena."

Interestingly, teachers tend to explain their beliefs about the nature of mathematics by giving examples of their teaching experience and personal experience dealing with mathematics. For example, when describing their beliefs about the skills addressed from learning mathematics, they seem to compare the options with their students' ability. This is indicated from P1, "Students at primary school are not asked for deals with a very abstract symbol or advanced mathematics topic. Rather, with the basic knowledge of mathematics, they are encouraged to use this knowledge to solve any real-life problem." Comparing with primary teachers, secondary teachers tend to describe their view based on their personal experience, instead of their students' experiences in doing mathematics. P2, for instance, says, "Mathematics teaches calculating. My experience tells you to need to have good calculating skills since in secondary school you will find many formulae that require you to be good in mathematical operation". P3 adds, "a learner would not be able to think mathematics creatively if he/she still have difficulties in certain mathematical procedures. That is why a learner should learn from calculating skills before learning more topics in mathematics such that he/she could think more creatively in solving the problem". Those two personal experiences indicate P2's and P3's hierarchical view about what should be learned in order, i.e. 1) calculating/applying formula, 2) understand various topics of mathematics, 3) creative and critical thinking.

The relationship between mathematics and the real-life problem

Instrumentalist view, which gives more attention to the functions of mathematics knowledge on its external world (Ernest, 1989), can be viewed from P1's statement. She says, "Not surprisingly that mathematics learned from elementary school to university will be used to solve any real-life problem. That is why students need first to learn how to calculate and how to use any mathematical formula before trying to solve any real-life problem." In this case, mathematical topics are learned to solve a real-life problem. A different perspective is revealed by P3. He argues, "Maybe there are currently math topics that seem to have not seen its function in the real problem. However, I'm sure at some point all mathematical topics will be applied in life. This is because all knowledge, including mathematics, is deliberately created to solve everyday problems." Thus, P3 emphasizes his beliefs on the application of mathematics in real life, although such an application is found in the future.

Furthermore, there are three primary teachers and 8 secondary teachers who declared Platonist option, which is there are part of mathematics that can be used to solve any real-life problems and there are other parts that can only be used for further mathematics itself. S2 argued, "I have not found a real-life application of topics such as factorization of algebraic form. It may only be useful to learn any higher mathematical topics, such as for polynomial problem. Meanwhile, topics such as percentage basic operation can be applied in real life, such as for selling-buying activities". In other words, this type of response view mathematics is divided into two part in relation to a real life problem, which is mathematics for mathematics itself and mathematics for real life.

The other view, which corresponds to a problem-solving view, indicates that mathematics and real-life problem are simultaneously used to solve either mathematics problem or real-life problem. P5, for example, gives his view about this matter, "The development of mathematics can start from either real life or pure mathematics itself. When starting from real life, mathematics evolved from solving a real-life problem, in which in this case, mathematics becomes a tool for solving a problem. When starting from mathematics, a real-life application is used as a way to help mathematician to develop higher topics in mathematics. In other words, both mathematics and real-life application could evolve together." P2 argues, "mathematics arises from everyday problems which then the experts formulated into mutually agreed forms. This was later developed in mathematical theories. These theories are used again to solve everyday problems, then from the solution of everyday problems, experts develop higher mathematics, and so on."

Beliefs about mathematics teaching

Table 9 presents primary and secondary teachers' beliefs about mathematics teaching distributed into seven issues related to mathematics teaching based on Instrumentalist, Platonist, and problem-solving view.

Table 9. *Teachers' view about Mathematics teaching*

Cases	Primary			Secondary		
	Instrumentalist	Platonist	Problem-solving	Instrumentalist	Platonist	Problem-solving
Role of teacher in mathematics instruction	-	-	All teachers	S1, S3	S2, S6, S8	S4, S5, S11 S7, S9, S10, S12, S13
The best instructional sequence for problem-solving instruction	P1	P3, P4, P5, P9, P10	P2, P6, P7, P8	S1, S2, S3, S9, S10, S13	S4, S8, S11, S6	S5, S12, S7
When to teach mathematics problem in real life	P1, P3	P2, P5, P8, P9, P10	P4, P6, P7	S4, S6, S8	S2, S5, S7, S9, S10, S11, S13	S1, S3, S12
Sources of problems used within problem-solving instruction	-	P1, P3	P2, P5, P8, P9, P10, P4, P6, P7	-	S1, S2, S3, S4, S6, S8, S7, S9, S10, S13	S5, S11, S12
How to minimize student misunderstanding on certain topics	P3	P1, P6, P10	P2, P4, P5, P7, P8, P9	S1, S2, S3, S5	S6	S4, S8, S7, S9, S10, S11, S13, S12
How to help students to deal with difficulties in solving math problems	-	P1, P3, P4, P5, P7, P9, P10	P2, P6, P8	-	S1, S2, S6, S9, S11, S3, S4, S8, S10, S12, S13	S5, S7

The role of teacher in helping students solve a problem-solving task

In this case, the instrumentalist view is represented as a view that teacher is the transmitter of knowledge and skills. Only two secondary teachers who selected this option and interestingly, no primary teacher who selected this option. In choosing this option, teachers, such as S1 and S3 have a similar reason. S1 pointed out, “As what I learned from my university, I know that this option [problem-solving option] is the best. But, I start to worry about that. I am now teaching at the school where the students are relatively low in mathematics. This makes me somewhat frustrated. Therefore, I change to position my self as a transmitter of math, rather than a facilitator. As such, I often explain certain topic by directly telling the topic related to the mathematics question being solved, rather than letting them find out the nature of the topic by themselves.” Thus, S1, as well as S3 related their options with the immediate classroom situation, primarily concerning students’ mathematics ability and behavior.

The Platonist view, on the other hand, is shown by a view that teacher is an evaluator of students' work. This option was selected by three secondary teachers. The arguments behind choosing this option, for instances, is argued by S8," by assessing every step of solving a mathematics problem, I will be able to investigate the progress of students' solution steps. This will minimize their errors to get the expected solution finally." S8 asserted, “I feel more satisfied when I could find any mistakes from my students’ work, then help them clarify the errors." The problem-solving view is indicated by a view that a teacher is a facilitator in exploring students’ knowledge and skills. Most secondary teachers, even all primary teachers asserted this option. S8’s reasons, i.e. “Teacher as a facilitator, in this case, means teacher give only necessary help when kids are trying to solve a problem. By this way, a teacher could notice the extent to which students understand the problem and construct some strategies to solve the problem.”

The precise time to introduce the real-life problem-solving task

There are two questions examined to teachers, i.e. when should you incorporate real-life problem in your teaching sequences? and what is the best teaching sequence you should apply when helping students solve the following problem?

Regarding these questions, an Instrumentalist view is indicated by a view that the teacher should introduce real-life problem after learning mathematical concepts/ procedures related to the problem. For instance, P1 says, “Concept of mathematics should be learned by students first before they start learning to solve a real-life problem. She asserted her view with her responses on the teaching of a division of an integer by a fraction. On the ‘rice problem’: "every day, a mother needs ¾ kg of rice for her family. If she has 25 kg of rice, on what day should she buy more rice?”, She responds, “I am not sure they will be able to solve this problem because they haven’t yet learned division of fraction such as 2÷1/2. They should understand the procedural step of the division of fraction first, which is turning the second fraction upside down, then multiply it with the first fraction.” Finally, he closes his statement, “The best method of teaching mathematics is by introducing a particular concept or mathematical formula, followed by giving some exercises, from easy to hard problem, and end up with solving a real-life problem”. A secondary teacher, S4, asserts this view by arguing that contextual problem is only suitable to be given at the beginning of the lesson if it is used only for apperception or motivation to show the usefulness of why studying the topic would be learned, instead of being used as resources of learning during the lesson. This implies the need for distinguishing between real life problem used as resources of learning and that as a tool that attracts students' motivation.

Introducing a real-life problem at the beginning of lesson become a statement which indicates teachers' problem-solving view. This view was stated by three primary and 3 secondary teachers. The problem for the secondary teacher: "the price of two glasses and one calculator is the same with the price of one glasses and three calculators, which is IDR500,000. Find the price of a glasses and a calculator", yields at least three views. Instead of first introducing methods of solving the system of linear equations of two variables, namely the method of elimination and substitution for later applied in solving the problem (as stated by S4, S6, S8), or presenting the questions in the easiest form, i.e. in the form of drawings, then asking students to think of a way to find answers by manipulating the images (as stated by S2, S5, S7), the three secondary teachers (S1,S3,S12) prefers to select option which invites students to use their own ideas in presenting the problem, either in the form of drawings, diagrams, graphs, or others and use the form of presentation to answer the question. Interestingly, a platonist view like S11 maintains her belief, “It does not matter whether at the beginning or the end of the lesson, that students work actively according to the lesson I have designed.”

Sources of problems used in instruction

There are three types of options which regard this issue. First, problem spontaneously designed during classroom activities or taken from a textbook or the internet. Neither primary nor secondary teachers selected this option. They agree that the quality of mathematics questions suddenly posed during a lesson is not as good as if the mathematics question is intentionally designed before the lesson. S4 argued, "this indicates that the teacher does not prepare the lesson well. The posed mathematics question will not likely elicit students' strategies because the teacher does not anticipate students’ various strategies or the question itself is not worth.” P5 added, "Problem from the book often gives various model of questions, which could develop students' problem-solving ability. However, students often find difficulties in dealing with such problems such as the problem which is too complex, and no clue." Thus, this view seems aligned with Instrumentalist view in teaching, which leads students to only learn from a particular resource.

Second, a problem designed by teachers. Most secondary teachers selected this option. They agree that the best source problem used in a lesson should be from the teacher. S4, for example, gives his argument, “Teacher knows the type of problem that should be used during a lesson because he/she has set learning sequence based on the expected goals of the lesson he/she already designed. Therefore, the problems can be developed by the teachers themselves." Interestingly, S4 compared his view by arguing that students will not much learn about the topic she is teaching if they are asked to pose a question first. She said, “I am worried that they will be able to design a mathematics problem since they never do it before. I prefer to modify the mathematics problem from book or internet by changing the numerical information or change the question and the information of a problem." Aligned with this view, P3 adds, “The lesson will take longer time if students posed their problem.” Thus, all these arguments indicate teachers' platonist view.

Third, the problem designed by students. Most primary teachers (8 teachers) and 3 secondary teachers chose this option. The teachers' reasons for choosing this option

vary around the discussion of students' creativity and attitude. For example, P6 argues, "I often ask my students to pose their question, either individually or in groups. Sometimes, the problem they posed will be discussed in the class discussion which then commented by their friends. I believe it improves students' creativity." Meanwhile, the students' attitude is drawn from the extent to which this activity attracts them to be more active and challenged. P7 gives her opinion, "although sometimes it is difficult for them to design a good problem, they seem motivated in sharing their designed problem in peers or class discussion." These all view, therefore, are aligned with the problem-solving view.

How to clarify students' misunderstanding within an instruction

An instrumentalist view is indicated by a view that teacher should provide more detail explanation on which the misunderstanding occurs. This option only attracted one primary and 1 secondary teacher. P3 argues, "It should better if we show on which parts the student finds difficulties so that we can clarify their work to the correct one immediately. This makes them understand more easily." Aligned with this view, S1 asserts, "Giving a detail explanation on certain parts of a topic will quickly remind them to decide the procedures they should apply." A Platonist view, on the other hand, is shown by a view that a teacher should engages students to be more active in the remaining lesson sequences the teacher designed before. There were only three primary teachers and no secondary teachers who selected this option. P6, in this case, emphasizes her view on the role of teachers to keep students focus on the learning objectives as the teacher has determined. She said, "No matter the students seems noisy in the classroom, as long as they learn what I expect." Meanwhile, a problem-solving view is shown by a view stating that teacher should give the opportunity to discuss their idea to compare which one could fix misunderstandings. Most teachers agree with this option (6 primary and 8 secondary teachers). Their idea support that students' difficulties and misunderstanding could be improved when the students share their ideas. In this view, S12 argues, "By providing other students' opportunity to share their idea, not only the students who find difficulties that will take benefits, but also the students who do not find difficulties would have another considerable perspective to solve the problem being examined."

First sentence to help students dealing with difficulties when solving a problem-solving task

To confirm the teachers' response on helping students deal with difficulties in solving a problem-solving task, we asked them to choose one of three options, i.e. "Tell what you think about the problem', which means diagnosing students' difficulties (problem-solving view), "In what parts you think this problem is difficult', which means demonstrating the steps of solving problem on which students think is difficult (Platonist view), and "Look at how I work out this problem", which means demonstrating procedures that solve the problem-solving task (Instrumentalist view)

In this regard, most teachers (7 primary and 11 secondary teachers) selected the Platonist view. There are two main reasons: saving time (for instance P3, P4, P7) and strengthening a particular step of solving the problem (P5, P9). The first reason, for instance, is indicated by P5. She says, "This will lead me to go directly to what makes them difficult so that I can guide them through a particular prompt". Meanwhile, the latter reason is shown by P5. He says, "Students often get stuck on certain steps of solving the problem. By asking them on what part they find difficulties, students will focus on improving their processes in such a part." To assert his view, P5 also compared with the other two options. He argues, "I think my students will be difficult to explain their answer on this type of question [the problem-solving view] since they are still kids. Furthermore, the scope of this answer is too wide for them although probably it makes them more freedom to express their idea. Meanwhile, surely, this option [the Instrumentalist view] seems to teacher-centered, does not give any chances for students to express their experiences." This might become reasons for all the teacher participants who surprisingly did not select the Instrumentalist view.

Beliefs about mathematics learning

Table 10 presents primary and secondary teachers' beliefs about how students should learn mathematics distributed into five issues based on Instrumentalist, Platonist, and problem-solving view.

How to improve problem-solving skill

There are three options each of which represents Instrumentalist, Platonist, and problem-solving view. To improve problem-solving skill, the instrumentalist view (2 primary, 5 secondary) suggest students exercise many times on similar problem to strengthen concepts, while Platonist view (3 primary, 2 secondary) suggest applying procedures demonstrated by teachers/provided in the textbook. Lastly, problem-solving view (5 primary, 6 secondary) suggest students foster their self-strategies based on knowledge and experience. Problem-solving view becomes the most frequent findings from both primary and secondary teachers (5 and six teachers respectively). In this regard, P2, for example, argues, "By this way, I will be able to diagnose the strength and the weaknesses of strategies found by

Table 10. *Teachers' view of mathematics learning*

Cases	Primary			Secondary		
	Instrumentalist	Platonist	Problem-solving	Instrumentalist	Platonist	Problem-solving
The best way for students to improve problem-solving skill	P3, P7	P5, P9, P10	P1, P2, P4, P6, P8,	S1, S3, S6, S7, S8	S2, S13	S4, S5, S9, S10, S11, S12
Variety of strategies students should learn	P3, P7	P10, P9, P1	P5, P2, P4, P6, P8	S1, S3, S6, S7, S9, S2, S13	S8	S4, S5, S10, S11, S12
Regarding mathematical formulas	P4, P9	P3, P10	P1, P2, P5, P6, P7, P8	S7	S1, S3, S6, S8, S10, S2, S9, S13	S4, S5, S11, S12
The use of calculator/ mathematical software	P3, P5, P9, P10	P1, P4	P2, P6, P7, P8	S1, S4, S6, S8, S10	S3, S7, S9	S2, S5, S11, S12, S13
Planning strategies for problem-solving	P2, P3, P7, P8	P1	P4, P5, P6, P9, P10	S1, S3, S11	S6, S10	S2, S4, S5, S7, S8, S9, S12, S13

students. This makes me easier to clarify their misunderstanding." In a similar vein, P8 asserts, "Students have their own strategies, which are not necessarily the same with their teachers' way". This view indicates that teachers tend to believe that exploring students' initial knowledge is important to give what kind of treatment should be provided for the student. However, there is a secondary teacher, i.e. S10, who seems inconsistent in expressing his belief. While agreeing that solving the problems given with students' own knowledge and experience, he also agree that students should still follow the direction of the teacher when experiencing difficulties and more specifically related to mathematical formulas, students must understand the process of deriving a mathematical formula, not just memorizing it.

In addition, teachers with Platonist view tend to believe that students should learn from what their teachers have taught because of two reasons, i.e. teachers' strategy is considered as the best so that it can inspire students to do so (e.g. P5, S2) and teachers' view assuming a lack of students' ability to create their own strategy (e.g. P9, S13). In general, all the teachers with Instrumentalist view, on the other hand, express their beliefs by arguing the benefits of having more exercises related to mathematical concepts, i.e. strengthening prerequisite skill which help students solve a more difficult task.

Variety of strategies students should learn

In this case, teachers were asked to give their view of the question: if students are provided with some strategies to solve a problem, which should they choose to select? The instrumentalist option regards to the view that students only need to learn one strategy considered as the best by their teachers; Platonist option regards to the view that students need to learn some strategies aligning with the topic they were studying at school by through an active discussion, while problem-solving option regards to the view that students need to learn as many as strategies from any resources. For those who selected Instrumentalist option, reasons emerge around the belief that teacher is deemed as the best person who can identify the focus of learning, including the selection of strategies they should present. This view characterizes teacher's role as the main learning resource for students to learn (teacher-centered). The Platonist view is indicated from the teachers' view stating that students need to discuss with their peers the best strategies that their teacher has presented to find the best according to them. In this regards, P10 argues, "although a teacher should facilitate students by providing some alternative strategies, students should select one strategy based on the results of discussion." Meanwhile, the problem-solving view, as revealed by S10, is indicated from the view of the existence of a chance for other strategies to be used in other problem solutions. S10, in this case, argues, "They (students) should better learn as many as possible strategies. Probably the strategies they finally do not choose for the problem they are solving, but on another occasion, such strategies will likely benefit to solve other types of problems."

The use of mathematical formula

The teachers were asked to select one of the options: instrumentalist view, i.e. using ready formula provided in the textbook (2 primary, 1 secondary), platonist view, i.e. understanding how the formula is derived (2 primary, 8 secondary), or problem-solving view, i.e. not dependent on using certain formula, instead, exploring self-strategies in needed (6 primary, 4 secondary). The latter option was mostly selected by teachers. Some reasons are identified around the view that ready formula is trusted so it can be readily applied for solving particular problems; it saves time. The reasons for Platonist option are around the view like revealed by S10, "Students are expected to not only memorize the formula but also understand the process of deriving the formula. This gives benefits when they forget the formula, they can derive again based on their experiences". Meanwhile, reasons for problem-solving view are around the view that was trying to use students' own formula, instead of only using ready formula, could develop student's skills to explore various strategies to solve any problems. Such skills, as S4 asserts, are much more important than only memorizing formula without making a sense with the core idea of the formula. Interestingly, although S7 selected instrumentalist option, he argued that using ready formula is not always bad. He maintains, "sometimes we need to memorize some formula to make our calculation faster so that we could complete all the questions in the provided time." This view points out that the skills of both deriving formulae and using any ready formula within the process of solving a problem is equally important.

The use of calculator in solving a problem

The instrumentalist option regarding teachers' view on the use of calculator is that calculator is not allowed at all. This option was agreed by four primary and 5 secondary teachers. The Platonist option regards to a view that calculator is allowed when students understand particular concepts/procedures, meanwhile the problem-solving option regards to a view that calculator is allowed provided that the problem being solved is focused on improving problem-solving. While the Platonist option was selected by only one primary and three secondary teachers, the problem-solving view was selected by five primary and 8 secondary teachers. For P1, the person selecting Platonist option, students are allowed to use calculator if only they have learned the basic concepts of certain mathematical operation. She said, "They will not learn a concept if they only rely on calculator. It does not provide an opportunity for students to learn a concept." This view is somewhat different from S1, the person at Instrumentalist view, who maintains that calculator only takes its function in real life application like in trading, instead of in school learning. S1 confirmed, "OK. It can be used only for checking the students answer, whether it is correct or not. I think it does not provide students an opportunity to learn concepts in math." Next, for those choosing problem-solving option believe that because the core skills of learning mathematics are not to calculate, but to reason and to think critically, calculator is allowed. In this regard, S12 argued, "I often ask students to use their calculator, primarily for a math question which encourage them to think using their understanding of a particular concept, although the 'numbers' presented in the question are large."

Teachers' MPSKT: Qualitative Results

The MPSKT examined to teachers consists of two types, i.e. problem-solving content knowledge (nature of problem, types of mathematical problem, problem-solving process, problem-solving strategies), and pedagogical problem-solving knowledge (setting problem-solving instruction).

Problem-solving content knowledge

Regarding problem-solving content knowledge, most teachers seem to have a partial understanding, especially about the nature of mathematical problems, types of problems, problem-solving processes, and problem-solving strategies. Teachers were given a set of mathematical questions and were asked to determine whether each of them is a problem or not for their students. Our analysis indicates that most of the primary teachers presume that

while a problem should be challenging, has no immediate solution/strategies, and interesting, a problem is also a question in which students have insufficient prerequisite related knowledge. For example, P3 says, "This question: find the area bounded by the curves $y= x^2-1$, $x= -4$, $x= 7$, and the x-axis' is a problem for my students because they need certain formulas that have never been studied before. The data also shows that most teachers explain the stages required by a solver to solve a problem which simply refers to first three Polya's stages,i.e. understanding a problem, devising a plan, and carrying out the plan with various mentionings. However, only a few indicating their answer leading to the looking back as suggested by experts (e.g. Mason, 2015). In explaining the implementation of the problem-solving process in class, P3 was unable to explain the ideal process to guide students to solve problems as indicated by his statement, "... I asked them to read the questions and listen to what I explained to understand the problem ... then let them choose the method and apply the method ..." This shows that his guidance is somewhat teacher-centered at the beginning of problem-solving.

Regarding types of problem, all the primary teachers did not explicitly mention some possible types as what most secondary teachers mentioned. While the primary teachers only mentioned two examples, namely mathematical problem and word problem, the secondary teachers mentioned, aside from those two, other examples such as open-ended problem, contextual problem, investigative problem, algebraic problem, and geometric problem. However, when interviewed about the idea of giving an example of an open problem, some secondary teachers found difficulties, while others could reveal their idea. For example, S5 expresses his idea about reformulating a more open-ended from a closed-ended problem. He says, "I will reverse the question, as if the area of a rectangle is 225 cm^2, then what are the possible sizes? Draw as much as possible an irregular plane with an area of 500 cm^2."

Pedagogical problem-solving knowledge

Chapman (2015) classifies pedagogical problem-solving knowledge into the knowledge of students as problem solvers and instructional practices for problem-solving. The first knowledge includes students' difficulties and students' thinking of what they can do, while the second one includes, for instances, understanding instructional practices for strategies and metacognition, different approaches which are fruitful and not, when and how to intervene during problem-solving process, and what to do when students are stuck. In this report, teachers' pedagogical knowledge were explored through a series of question, "what do you guide students to (1) understand a problem, (2) devise a plan for strategies, (3) carry out the plan, (4) evaluate the results ?, and how can you develop your students' problem-solving strategies?

About pedagogical problem-solving knowledge, interestingly, all the teachers seem to indicate sufficiency to explain how problem-solving processes are implemented in learning. It is indicated by the findings that the student learning experiences expected to occur are in the category of consultative teaching, the teaching that supports the idea of giving students opportunity to construct their own idea within problem-solving activities (Blum & Ferri, 2009), instead of directive teaching, the teaching that seen as an instructor, which support the idea of practicing students on certain problems (Antonius et al., 2007). Some points of consultative teaching were mentioned, for examples, around starting lesson by asking students to understand problems such as choosing relevant and irrelevant information (all teachers), identifying those given and not given but necessary (P3, P4, P5, S3, S4, S5, S9, S13), encouraging to think creatively on each idea in an effort to find the correct mathematical model (all teachers), providing feedback on their strategies and finally ask them to consider whether the solution they found makes sense or not (all teachers, except P2, P3, S3), promoting students to share their solutions and strategies in a discussion session (all teachers).

Discussion

This study examined Indonesian primary and secondary teachers' beliefs about the three mathematics-related beliefs: nature of mathematics, mathematics teaching, and mathematics learning, and mathematical problem-solving knowledge for teaching. Results found that that there is no significant difference between beliefs across level grade of teaching. In other words, in the same location, the teacher beliefs tend to be the same although they are in the different grade level of teaching. This is in line with the findings that teachers tend to have a similar belief in the same culture, which is culturally located and culturally conditioned (Xenofontos, 2014, 2018). This means that various contextual factors, such as educational policies, the structure of the educational system, and mathematics education in particular, and so on (Wong, Tana, & Veloo, 2001) have a strong impact on teachers' beliefs to such an extent that more differences can be observed across educational systems, countries, and cultures than within the country addressed each time. Besides, cultural beliefs stated by Cai and Wang (2014), in which teacher beliefs are rooted in, and constrained by, the culture of the society in which the teachers are living and working, give higher impact on forming teacher mathematics-related beliefs rather than that of the different grade level of teaching.

This is not to compare which group of teachers who have a more constructivist belief or a higher understanding of MPSKT between primary and secondary teachers. Rather, this is to compare the unique characteristics drawing on the knowledge and beliefs held by primary teachers and secondary teachers. Regarding teachers beliefs, we found that the teachers' responses are not fully consistent in one domain of beliefs. For example, in this research, the teachers tend to agree that mathematics teaching is important to understand the relevant problem and context, but on the other hand, they also agree that mathematics problem-solving should be done quickly and instantly.

The beliefs about nature of mathematics of the teacher participants were indicated to be neither completely Instrumentalist, Platonist, nor totally problem-solving. Likewise, corresponding beliefs of each of mathematics-related beliefs in the Beswick's summary also were also not totally held by the teacher participants (Zhou as cited in Xie and Cai, 2018). While inconsistencies might occur between the three domains of mathematics-related beliefs, it also occurs between particular issues discussed in one domain. For instances, teachers' view on a particular issue, such as dealing with a mathematical formula, calculator, and which somehow platonist or even instrumentalist, does not support their views about how to teach and learn mathematics based on their own version which is somehow problem-solving. As evidence, P4 believes that the role of teacher in mathematics instruction is a facilitator (problem-solving), but she also believes that to clarify students' difficulties when solving a problem-solving task is by asking the parts of difficulties and then prompting some questions that guide students solve the problem (Platonist), and even she agrees to give some rewards is the best method to increase students' learning motivation (Instrumentalist). Interestingly, although these inconsistencies occur, some of the teacher participants do not fully put their selection only in one option. They have selected the option which best represents their idea about a particular issue, but they have also sometimes somewhat agree

with the other options, although the degree of preference is not as much as the option he/she selected. In sum, all the abovementioned evidence reflect the view that belief systems are not necessarily logically structured; therefore it is possible for a teacher to hold an inconsistent belief (Andrews and Hatch, 2000; Thompson, 1992; Xenofontos, 2018).

The results bring a wider perspective of the potential factors causing such inconsistencies. First, the fact that some participants understand the nature of the problem without fully understanding the variety of problem-solving strategies points out that insufficient MPSKT leads to different beliefs even within one knowledge domain. Second, primary teachers have a various background of education; only a few were graduated from mathematics education program, some were not graduated from primary education; instead, they were graduated from the non-educational program, while secondary teachers were all graduated from the mathematics education program. Therefore, it is possible that the volume of MPSKT the secondary teachers obtained was more than that of the primary teachers did. Thus, teachers' past experience of becoming students influence how they view mathematics (Raymond, 1997). The MPSKT of secondary teachers was found better than those of primary teachers. The possible explanation is that, again, their schooling particularly when they studied at their undergraduate level. In Indonesian teacher education curriculum, institutions which have a responsibility to produce mathematics teachers have some courses both in mathematics and education. This is quite similar to the curriculum provided in primary teacher education. However, the courses of mathematics provided in the secondary program have more various types ranging from school mathematics to pure mathematics, which are not found at primary teacher program.

In giving emphasis on the priority of learning mathematics, teachers across countries also give a different view. While teachers at the U.S within the study of Cai and Wang (2009) put more emphasis on student understanding with concrete examples, and the sample of Chinese teachers put more emphasis on abstract reasoning after using concrete examples, Indonesian teachers at this study put their view on abstract reasoning before using concrete examples or with concrete examples. Many of our samples in the second year project, both primary and secondary teachers, believe that students should learn from abstract reasoning, e.g. by strengthening their mathematical concepts and procedures, before they learned its concrete examples. P1, for instance, believes that it is difficult to put a concrete situation of a real-life problem at the beginning of their lesson for students to solve since the concepts related to such problem is included in some mathematical theories would be discussed. Only a few of them put their emphasis on student understanding with concrete examples. S2 agrees that using concrete examples can be used as a context for learning, which means problem or examples should be put during a learning process, although he does not frequently use concrete examples in his teaching. As he stated regarding the relationship between mathematics and real-life problem, not every math topic has its concrete application in real life; therefore it is difficult to select a good problem for a lesson. In relation to their MPSKT, it is hypothesized to be related to the content knowledge of problem-solving, in which they found difficulties in selecting appropriate problem used in any situation, both for only apperception of a lesson, for being discussed during the lesson, or for being worked after having done with the lesson. Thus, the finding that P1 has insufficient knowledge of understanding the nature of problem and identifying types of problem, as well as limited knowledge of problem-solving strategies, is in line with her Instrumentalist view on using concrete examples in a lesson (see Siswono et al., 2017). In other words, this finding supports the view that knowledge and beliefs are not isolated entities, which teacher beliefs may take some roles as a mediator between teacher knowledge and teacher practice (Wilkins, 2008).

In this study, we highlight that beliefs about nature of mathematics were mainly influenced by teachers' experience when learning mathematics at their schooling experience (especially at primary until secondary), while beliefs about teaching and learning were mainly influenced by current reform of curriculum of mathematics for primary and secondary level. As evidence, P1's view about mathematics, i.e. the objects of mathematics will be remaining same over time while strategies used to find out such objects may change, indicates her experiences when learning mathematics at her past schools. Meanwhile, the teachers' hesitant to break their habit, as found on S1's view about teaching problem-solving task, such as teacher dependency on the book dropped by the government, points out that teachers trust on the quality of problems or teaching approach proposed by the book as the product of current curriculum. Additionally, the change of beliefs about teaching mathematics, from traditional beliefs to constructivist beliefs, as exemplified by the story of S1's teaching experiences, indicates that the change of curriculum influence teachers' current view about teaching mathematics. Something to worry about is that they only take a role as curriculum implementer who waits for the instruction as a form of responsibility as the mandate from the government (Purnomo, 2017), in which what they do is not because of what they believe. Instead, it is because of the demands of the current curriculum.

Conclusion

This study highlight that there is no significant difference between the MrB of primary, lower, and secondary teachers, while there is a significant difference between MPSKT of primary teachers and both lower and upper secondary teacher. However, there is not any significant difference between MPSKT of upper and lower secondary teachers. Also, this study suggests that inconsistencies not only occur between the three domains of MrB but also occurs between particular issues discussed within one domain. Potential factors causing such inconsistencies are identified around insufficient knowledge of particular components of MPSKT and various background of teachers' past education. Also, teachers' experience when learning mathematics affects their beliefs about mathematics, while current reform of mathematics curriculum affects their beliefs about mathematics teaching and learning.

To suggest, since the MPSKT of primary teachers are relatively worse than that of secondary teachers, we stress the importance of encouraging primary teachers to get involved in some professional learning focusing on improving problem-solving knowledge (content and pedagogical). The professional learning could give some problem-solving experiences such as understanding the nature of problem and posing a worthwhile problem (Leavy & Hourigan, 2019), posing context-based problem (Ekawati et al., 2017; Kohar et al., 2019, Siswono et al., 2018b), or posing problem-solving task to bring such task into a teaching practice (Siswono et al., 2018b).

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Slowmation Application in Development of Learning and Innovation Skills of Students in Science Course*

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Abstract

The objective of the present study is to determine the effect of the process of designing a slowmation (SMA) on the development of 21st century skills of "learning and innovation" in 4th grade science class "Light and Sound" and "Planet Earth" units. Study group included 44 students attending 4th grade in two private schools in Southeastern Anatolia region. Four female and five male, a total of nine focus students were determined in the study group where the application was implemented. The study was conducted in 17 weeks (51 periods), out of which six weeks spanned the pre-application process and the application lasted for 11 weeks. Different data collection tools such as video records, semi-structured interviews, group audio recordings, 21st century learning and innovation skills scale r and student diaries were used to collect data in the study. Quantitative data were analyzed and interpreted using SPSS software. Qualitative data were analyzed with descriptive analysis. Overall results of the study demonstrated that slowmation application resulted in the development of 21st century learning and innovation skills, namely creativity and innovation, critical thinking and problem solving, collaboration and communication skills.

Keywords: Science Course, 21st Century Skills, Learning And Innovation Skill, Slowmation, Primary School

Introduction

In 21st century information society, expansion of knowledge, becoming available for the masses and the necessity of different cultures to live together resulted in individuals to encounter more technological, economic, social and cultural changes along with the phenomenon of globalization. Thus, it is expected of individuals to adapt to changes and continue their lives, follow the technological advances, be able to select and analyze the information within the bulk of knowledge that is produced and circulated rapidly, use the information they collected in their daily lives and transform the information into products.

This change and transformation make it possible for the individuals to access information faster, use the information they accessed in their daily lives, and find solutions to several problems they encounter. In the present century, what is significant is now how individuals access the information, but how they would analyze and utilize the information they access in their social lives. Thus, the expectations from the individuals change in the 21st century as well (Wagner, 2008).

The skills and competences that the individuals should possess in 21st century are called 21st century skills. 21st century skills do not involve only skills or knowledge. 21st Century skills include understanding and performance. In other words, it is a concept where knowledge and skills are blended (Dede, 2009). 21st century skills, where knowledge and skills are used in conjunction, are skills that are necessary for individuals to lead more quality lives, solve the problems they face more easily, perceive and analyze the events in society through different perspectives and to attain more success in their professional and social lives. Different institutions classified 21st century skills in different ways. According to P21 (2009), 21st century skills are learning and innovation, life and career, knowledge, media and technology skills; according to NCREL, they are creative thinking, active communication, high productivity, and digital age literacy; according to ATCS, ways of thinking, ways of working, and tools of living and working in the world; according to NETS/ISTE, creativity and innovation, critical thinking, problem solving and decision-making, communication and collaboration, digital citizenship, technological applications and concepts, research and information fluency; according to EU, learning how to learn, communication, cultural awareness, social and citizenship competency, entrepreneur sensibility, digital competence; according to OECD, interaction with heterogeneous groups and use of technology tools. Although the 21st century skills were classified differently, there are similarities among these groups. 21st century skills focus on creativity, critical thinking, collaborative work and problem solving. Individuals could achieve 21st century skills classified under different topics throughout all educational steps from primary school to higher education. Education should train individuals that could meet the demands of the 21st century and cope with the problems of that new age (Tutkun, 2010). Thus, it could be stated that acquisition of 21st century skills could be considered as the primary goal of primary school curricula in preparing the children of today for the future. One of the basic courses where 21st century skills could be acquired is the course of science.

Science curriculum focuses on students to be individuals that integrate and comprehend the skills, attitudes, values, understanding and knowledge on fields of science to develop research-examination, critical thinking, problem solving and decision-making skills, become lifelong learning individuals, sustain their curiosity about their environment and the world (Efendioğlu 2012; MEB, 2005; Ürey & Çepni, 2014). In the educational process that would be designed to enable students to reach these goals and objectives described in the curriculum, it is quite important to utilize multimedia simulations. Because, multimedia simulations do not only facilitate students to reach cognitive goals and objectives, but also develop their affective traits that they would require in learning and teaching processes such as attitude and self-efficacy (Efendioğlu, 2012). Furthermore, it is significant to use

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educational technology tools in science classes to enable students to achieve a versatile understanding of events and objects, ability to interpret these, develop their creativity and to maintain their interest in the class (Akpınar, Aktamış & Ergin, 2005). There are several technologies that are used or could be integrated in science education such as the Internet, simulation, probe-ware, multimedia and hypermedia (Alkan, 2011). Integration of technology in different perspectives in the education resulted in different learning-teaching approaches. Especially, one of the effective learning-teaching approaches used in science instruction is slowmations (Keast, Cooper, Berry, Loughran & Hoban, 2010). Animations could assist students to imagine the phenomena that occur in science courses and abstract knowledge shaping as concrete conceptions in students' minds (Atılboz, 2004). Design process of slowmation includes first the production of the models and later creation of digital photographs that reflect small sequential movements of these models to obtain an animation effect, and the process is concluded with transfer of these digital photographs into a digital video software (Kervin, 2007). Slowmation simplifies the complex process of animation creation and provides an opportunity for primary and middle school students to design their comprehensive animation on scientific concepts (Hoban, 2005, Hoban & Ferry, 2006, Hoban, 2007; Hoban, 2009). The most particular characteristics of slowmation is that there are only two frames per second, not 24 frames per second like in computer animations. Because, here the purpose is not to present a story, but to demonstrate and explain a scientific concept (Hoban, 2007). Slowmation is the creation of digitally shot and manual controlled model photographs with the stop-motion technique (Laybourne, 1998). Slowmation process includes four phases of planning, where learners research how they would present the concept or subject that includes the changes and where the tasks are shared; narration, where the stories that support the investigated, selected and developed subject; production, where models are constructed and photographed; and reproduction, where digital pictures are uploaded into a computer and sequenced, and transferred into a computer software and turned into an animation (Hoban, 2007). Especially the increasing use of digital technologies in science education makes it possible for the students to present the content in different ways. For instance, students could present scientific concepts using two- or three-dimensional videos or animations with short stories. Ability to show the same concept in different ways would enable students to reflect their thoughts in the content. Furthermore, the ability to reflect their thoughts in the content would promote students' creativity (Hoban, Loughran & Nielsen, 2011). In addition, if students are encouraged to explain and share scientific concepts with their peers, they would also acquire communication and presentation skills (Hoban & Nielsen, 2013). Although there are international studies on the utilization, production and effects of slowmation in the learning-teaching process, no studies that scrutinized the approach were conducted in Turkey. The objective of the present study is to determine the effect of slowmation application on the achievement of 21st century "learning and innovation" skills by the students attending primary school 4th grade sciences course. Thus, the following research question was determined:

- How students use and improve 21st century learning and innovation skills in slowmation creating process during 4th grade science course?

Method

Research Model

The present study aimed to determine the effect of slowmation application on the achievement of 21st century "learning and innovation" skills in primary school 4th grade physical sciences course was conducted with a mixed method, where qualitative and quantitative methods were used together. Mixed methodology is the use or blending of qualitative and quantitative research techniques, methods, approaches or concepts in an integrated manner in a particular study (Creswell & Plano Clark 2006; Creswell, 2009). In the present study, embedded experimental model of mixed methods based on qualitative data, supported by quantitative data, and quantitative-qualitative method variation based on dominating status paradigm emphasis was utilized. In this design, a study based on qualitative or quantitative data attempts to answer the research question, while utilizing quantitative or qualitative whenever needed (Plano Clark et al., 2008). The quantitative part of the study was designed based on the empirical design of pretest-posttest with control croup. One of the two groups determined randomly was used as the study, and the other as the control group. Pretest and posttest measurements were conducted in both groups in this model. Based on the research question, quantitative data were used in the beginning and at the end of the empirical study, and qualitative data were collected with semi-structured observation, interview, video and audio recordings, student and researcher diaries and document analysis, so that qualitative and quantitative data would complement each other, and thus, a more valid and reliable data were obtained.

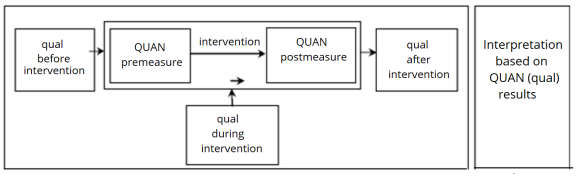


Figure 1. Embedded Experimental Model (Creswell & Clark, 2007)

Participants

Participants of the present study included 4th grade students attending two schools located at a city in Southeast Anatolia in 2014 – 2015 academic year fall semester. A draw was conducted among 4th graders to determine the study and control group members. The class 4A with 22 students was determined as the test group and the class 4A with the same number of students was assigned as the control group. The study was conducted with 4th graders because this class level was suitable for the achievement of the skills such as critical thinking, problem solving, creativity, collaboration and communicative cooperation, determined as 21st century skills in literature, when cognitive development levels of the students are considered.

Selection of the participants for the qualitative part of the study was conducted with criterion sampling, one of the purposeful sampling methods. Purposeful sampling allows in depth study of situations that are assumed to contain vast information (Yıldırım & Şimşek, 2008). Purposeful sampling is widely used in qualitative research for the identification and selection of information-rich cases related to the phenomenon of interest (Palinkas et al., 2015). Attending the 4th grade in a middle socio-economic level school was the main selection criterion for the students in the current study. In the study, a total of 9 focus students, out of which four was low level, three medium level and two high-level, were determined based on the data obtained after pre-application observations, and the interviews conducted with the students identified based on the scores they received in "21st Century Learning and Innovation Skills" scale were selected. Number of focus students was determined based on the classroom size and mean scores the students received in the scale. The names of focus students were coded for ethical reasons.

Data Collection Tools

In the study, which was designed in embedded experimental design, necessary data to respond to the research question were collected with researcher and student diaries, semi-structured interviews, video and audio recordings, and student products. Furthermore, in the quantitative section, "21st Century Learning and Innovation Skills" scale that developed by researchers was utilized. Draft scale consisted of 60 items. Opinions of five experts in the field were consulted on the draft scale. The experts scrutinized the items based on their suitability for the dimension, comprehensibility of the expressions, whether the items concerning the skills under each dimension reflected all the characteristics of the related skill, and whether these were suitable for fourth grade students. As a result of expert assessments, four statements that were not suitable for the level of students and comprehensibility of the statements were excluded from the scale, while five statements that did not reflect the related skills completely were edited. To determine the answering duration and comprehensibility of the scale, the 56-item scale was applied to 30 fourth grade primary school students in the pre-test stage. As a result, two statements that were not understood clearly by the students were edited. 56-item draft scale was thus finalized. During the following phase, the scale was applied to the students and scores obtained from the scale were analyzed. Exploratory factor analysis was conducted on obtained data to determine the structural validity of the scale. In this process, primarily Kaiser-Meyer-Olkin (KMO) and Bartlett Sphericity tests results were examined, followed by the common factor variance values for the items, eigenvalue line graph, principal components analysis results, and "verimax" rotation technique results, conducted to obtain interpretable variables. As a result of the interpretation of the above-mentioned data, the scale was finalized. Cronbach alpha reliability coefficient of the scale, where 39 items were grouped under three factors, was determined as α= .955.

Implementation Process

Slowmation application conducted in primary school sciences class was instructed within the context of 4th grade "Light and Sound" and "Planet Earth" units. Both units were redesigned to comply with slowmation application. Slowmation application lasted approximately 11 weeks. The first week of the study was reserved for the instruction of the slowmation application. For two class periods, information was presented to the students on how to produce animations and for one class period different animations produced on different subjects were presented as samples. Thus, the students had a preliminary idea on what kind of an application they face and what they could do with the application. In the test group, students produced two slowmations per subject determined based on the course syllabus. They researched and structured the information in the planning stage and then transformed the information they obtained into a story in the narration stage. When the story was ready, the production stage where the story was animated with models was initiated. After the models were created, the models were set in motion with photographs in the same stage. In the final stage of reproduction, students differentiated their animations by voicing over the stories or applying different effects to the animations. In that stage, the products were assessed by the teacher and other group members in the classroom. In every stage of the slowmation creation process, the students were evaluated using classroom observation form. Furthermore, at the end of each unit, interviews on the process were conducted with determined focus students.

Data Analysis

21st century learning and innovation skills scale was used as quantitative data collection tool. Obtained qualitative data were analyzed based on the objectives of the study to solve the research problem. Statistical analyses were conducted with SPSS software. For the analyses, arithmetic mean and standard deviation of participating students' pretest and posttest scores were calculated. To respond the research questions, in-group comparisons were conducted. In-group and between-group comparisons were conducted with t-test. Descriptive analysis technique was utilized in the analysis and interpretation of qualitative data in the study. In descriptive analysis, obtained data are summarized and interpreted based on pre-determined themes. Data could be organized based on the themes identified by research questions, or could be presented with respect to the questions or dimensions identified during the interview or observation processes. Frequent direct quotes were used to reflect the views of the observed or interviewed individuals (Yıldırım & Şimşek, 2008). Collected application data were regularly analyzed in the present study. At the end of the study, all collected data was readdressed using descriptive analysis and the relationship and consistency between the collected data that was collected throughout the study were scrutinized.

Findings

In this section, learning and innovation skill development using slowmation was examined in every stage of the application. For this purpose, the class of 22 individuals was divided into four groups (5-5-6-6). Planning, narration, production and reproduction stages of the application were conducted with the achievements depicted in the related units of the sciences course in mind. Each stage was assessed based on learning and innovation skills (creativity and innovation skills, critical thinking and problem-solving skills, and communication skill).

During the first and planning stage of slowmation creation, students could research a particular subject or concept or the teacher could assist students in learning a subject or concept by structuring it for the students. In the planning stage of the present study, research questions about the subject within the framework of the achievements of sciences course were presented by the teacher. The information was structured in classes shaped around these research questions. "Learning and innovation skills" that students used and developed in the process in each stage are presented in Table 1.

Planning Stage Findings

In planning stage, sub-skills such as "taking notes, producing solutions, wondering, reading and research, imagining, using new technologies, following up scientific journals, creating products," where "creative and innovation skills" were utilized and development of these skills was identified, were determined.

The author noted the finding that students were not able to take notes in the researcher's diary as follows: I asked students to observe light sources by projecting light on the mirror, reflector, aluminum folio and iron spoon both in darkness and in ambient light and write the results in their notebooks. Furthermore, I asked whether the moon and stars were light sources. I asked them to research the answers and write the findings in their notebooks. However, most of the students asked me to write the homework at the board. They have copied what I wrote on the board to their notebooks. In fact, Berk asked what to write as the

Table 1. *21st century learning and innovation skills that students used and developed during the process*

		Slowmation Stages			
		Planning	Narration	Production	Reproduction
Creativity and Innovation Skills	Taking notes	√			
	Producing solutions	√	√	√	√
	Wondering	√			
	Reading and research	√	√		√
	Imagining	√	√	√	√
	Following up scientific publications	√	√		
	Following up new technologies	√	√	√	√
	Creating products	√		√	√
Critical Thinking and Problem Solving Skills	Research on a particular subject	√			
	Classification and comparison	√	√	√	
	Giving examples	√			
	Justification-inference	√			
	Asking questions	√			
	Explaining knowledge using different material	√			
	Recognizing the connection or contradiction between acquired knowledge.	√			
	Predicting the solution	√			
	Transferring knowledge		√		
	Summarizing the subject	√			
Collaboration and Communication Skills	Asking questions in the class or the group	√	√	√	√
	Communication with peers	√	√	√	√
	Cooperation, support and motivation		√	√	√
	Providing constructive solutions to conflict			√	√
	Listening to ideas and criticizing performances			√	
	Sharing and integrating knowledge			√	√
	Sharing the job	√	√	√	

title of the homework. However, the expressions of the students in entries dated the following days in their diaries that show they have started to use this skill are as follows. Berk wrote; I wrote down all information I searched at the Internet. I brought the notebook to the classroom. Since everyone wrote down, too, we were all had common knowledge; Irmak wrote; I researched and also printed it out. But, since the teacher would not allow me to read, I underlined the passages that I would explain as such. I will talk about these findings; Aras wrote; I researched as well, but did not write it down. If I take note in small headlines, I remember them better. I took notes like that. Student statements showed that they have used and developed the skill in the process. It was observed that students obtained information and came up with different solutions to problems they encountered. Researcher's observations and student statements show that students wondered about things and conducted research, gathered information and then asked their questions accordingly during the planning stage. Berk said; There are these things on mount Nemrut, the heads, they are cold during the night, and when the morning comes, they crack. In the evenings, they get cold again as a result of things like rain and become stone again. Could this be an example of erosion? Because, when they crack, they fall off. When I visited there, there were stones like that around. It was determined that students conducted reading and research out of given subjects albeit limited at first, but increasingly as the time passed in the planning stage. It was observed that students who were surprised with an example from the book presented by the researcher started to give examples from different resources in the classroom after that event.

In the interview conducted with students at the end of the unit, they stated that they have used various resources in the research process. Eda; For instance, I read some books. I learned a lot from these books. In fact, I don't like reading much. But, when I started researching I wanted to look at everything continuously. Some, we had at home. Some others, I bought anew. Researcher took the following notes on the diary about the change in student's behavior later on: I liked the way students shared information and they studied the subject they researched very well. Now, they could freely read about what they search for and even could tell about it using their own words. Can showed me the visual dictionary he bought from TÜBİTAK publications. Mehmet also said he liked it very much and would like to buy it as well. Enes and Tolga came to me in the recess and asked me where they could buy such books. This week TÜBİTAK press would open a stand at school. They have never came before, this would be their first time. Students showed quite an interest. The attendant at the stand told me he had sold a lot of copies of the book on light to the class I teach. I was really happy. In planning stage, students demonstrated their creating a product skills partially or effectively with the drawings they created.

In addition to creativity and innovation skills, it was determined that "critical thinking and problem solving skills" were also used and improved in the planning stage as evidenced by skills such as "conducting research within a subject matter, classification and comparison, giving examples, justification-inference, asking questions, explaining the knowledge using different material, recognizing the connections or contradictions in obtained information, predicting solutions, and summarizing the subject." It was determined that students conducted research

based on a subject given by the researcher in the planning stage. During this stage, students conducted research and shared the results in the classroom. It was observed while the students shared their knowledge that they have read about the subjects they researched and their research was not incidental. Thus, it could be argued that their research was purposeful. Students reflected the fact that they conducted research to access more information in their diaries as follows: Esra; I completed my homework today by doing research in the books. When there was a shortcoming I first asked my mom and then searched the Internet. Doing such a homework was great fun. Finally, I finished my homework. Tolga; I find the results of the homework teacher gave by searching the Internet and completed my homework by accurately noting down the things I found on the Internet. I will go to school tomorrow with my homework completely finished.

In the interviews, students expressed similar statements. Berk; I did my homework using the Internet and books. First, I browsed the net to collect information about it. I took notes on paper. I searched the Internet. I printed them out on the printer. I checked the resources at home and textbooks. I combined the information I gathered. I printed out pictures as well. It was identified that students were not able to use classification-comparison skills in the initial process in planning stage, but developed it during the process. It was observed that the students, who did not even understand the question about classification, demonstrated improvement later on. Later in the process, a conversion in the classroom was realized as follows: Irmak; while other lamps turn most of the energy into heat, fluorescent bulbs, on the contrary, convert all the power into light. Fluorescent bulb is economic; they consume less energy. However other bulbs are not like that. They consume a lot of energy. In addition, other bulbs get heated a lot, but, in my opinion, fluorescent bulbs do not get warm a lot. Enes; fluorescent bulbs provide more illumination than regular bulbs and are more economical. Gonca; fluorescent bulbs radiate more light, while regular bulbs radiate a lot less. Eda; while regular bulbs consume a lot of energy, fluorescent bulbs consume little energy.

It was identified that students utilized and developed "collaboration and communication skills" and sub-dimensions such as "asking questions in the classroom of the group, communicating with peers and task sharing" in the planning stage. In the planning stage, students are expected to communicate with each other by asking questions about the subject they research. Eda and Mehmet, two students from the third group asked about the things they were curious about or stuck in their minds about the Planet Earth unit to their group members. The conversation among group members was as follows: Eda; When we pour water on the soil, does it go into the underground water? Ece; I mean; this water is then used after treatment. They treat water the same way in places where the water is polluted. Mehmet; When it rains, I mean it rains too much, when the underground waters increase a lot, would 4/4 be covered? It was determined that students asked questions in the group and the classroom and developed these skills by using them in the process. While groups experienced communication problems in the beginning, as time passed by, they have resolved this problem. Students wrote the following on the subject in their diaries: Esra: We have poor communication in the group, no one listens to others. I think we won't be able to complete the animation in time. In the upcoming stages of the process, Eda; Everyone expressed their ideas in the group. Then we selected one of them. We decided to create a story by adding little by little from some of these information or all of it. Thus, research done by all will be used. We will combine them all to write a story.

Narration Stage Findings

It was determined that students utilized and developed "creativity and innovation skills" in the narration stage and the sub-skills of "producing solutions, reading and research, imagining, using new technologies, and following scientific journals" were identified. While students did not use these skills in the Light and Sound unit, it was determined that they utilized these skills in the Planet Earth unit. It was also determined that, as an alternative to narrating the animation as a story, students thought about narrating their stories as a poem and produced a different solution. Eylül stated the following in the interview conducted at the end of the unit: Since the subject was the earth, we named our characters as star, sun, etc. Then, primarily Merve did the research, and everyone shared the information they researched, and then I wrote all by hand. We tried to transform the information into a poem. That idea to write a poem occurred to us. At first, we just thought about it. We tried to provide different information than what everyone knew. Since the students thought about different ways of expression when creating their models, they differentiated their narratives based on the models they created as well. Thus, they altered their stories based on the models they created. Middle level focus student Eda expressed her opinion on the subject as follows: First, in the lithosphere, Gonca wanted it this way, then we made additions, we added a lot of information to make it better. For instance, when building models, we first think this should be in the story as well, and then we decide it would be in the story. In fact, when we were creating the models our story changed, but it became better. When creating their stories, it was identified that they have referred to the information they collected while reading and researching in the planning stage, and did research when they require further information in this stage as well.

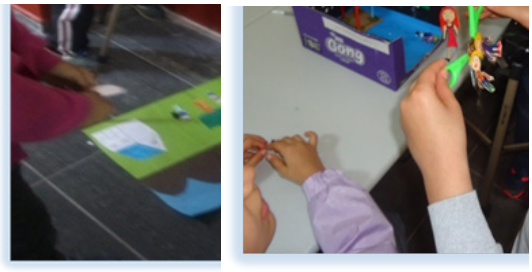
In narration stage, it was found that "critical thinking and problem solving skills" were utilized only at the level of classification and comparison and transfer of knowledge and developed during the process. The fact that students compared their products within the context of classification and comparison was exhibited in the interviews with students. Eylül; In fact, I wanted to share a lot of information, but then it became too long. Then, we briefly talked about the layers and volcanoes. A little bit about erosion We explained landslides due to erosion. In our last animation, there was not much information, and hence, we tried to provide as much information as we could in this one. It was also identified that students transferred the knowledge they acquired from different resources into their stories. Esra summarized this fact as follows in her diary: On the poster in "Lemon Office supplies," there was a great text. I received help from that one.

In narration stage, it was determined that students utilized "collaboration and communication skills" and development of these skills were observed in students and the following sub-skills were identified: "asking questions within class or the group, cooperation, support and motivation, communication with peers and division of labor." In narration stage, students are expected to ask questions to each other, communicate while completing their stories when writing a story on a subject of research as a group or in the classroom. Students asked the following questions about the subject: Berk; Teacher, can we do this in the form of funny stories? Eda; Will we include all information we could find? Eylül; For instance, teacher, you have given an example. There was Cedric, can we create characters like him? Esra; Should we narrate Edison's life or the bulb, which one would be better? Berk; Let's start with Edison, and at the end we could say that he invented the electric bulb. At that date researcher made a note about this in her diary as follows: Students completed the first story in

the unit today. I observed that students tried to avoid the mistakes they did in the previous unit. They wrote stories where they could implement simpler models. Different from the previous one, they wrote the stories after serious consideration and asking many questions to each other to improve their stories and animations. As in other stages, groups members are expected to share the tasks between them and fulfill their responsibilities effectively in the narration stage. It was observed that the groups were not able to fulfill the given tasks completely in the beginning of the process. Students in the same group reflected their views on the failure of division of labor in the beginning of the process in their diaries as follows: Yasin; Task sharing failed a little. Because, no one listened to what others had to say. We were not able to do anything in the class today. Esra; Even we shared the tasks, everyone expects me to do everything. I don't understand why we are a group in the first place. We are behind all groups. We have to work very hard. In the forthcoming stages of the process, students stated in their diaries that they have finally managed to share the tasks and fulfilled the responsibilities of the assigned tasks as follows: Irmak; They elected me the group president to assign tasks. We gave a task for everyone. Sometimes we make something like a meeting. For instance, when we assign a task to someone, it won't work, and I check it out. But, now, I can say that everyone does what they are assigned.

Production Stage Findings

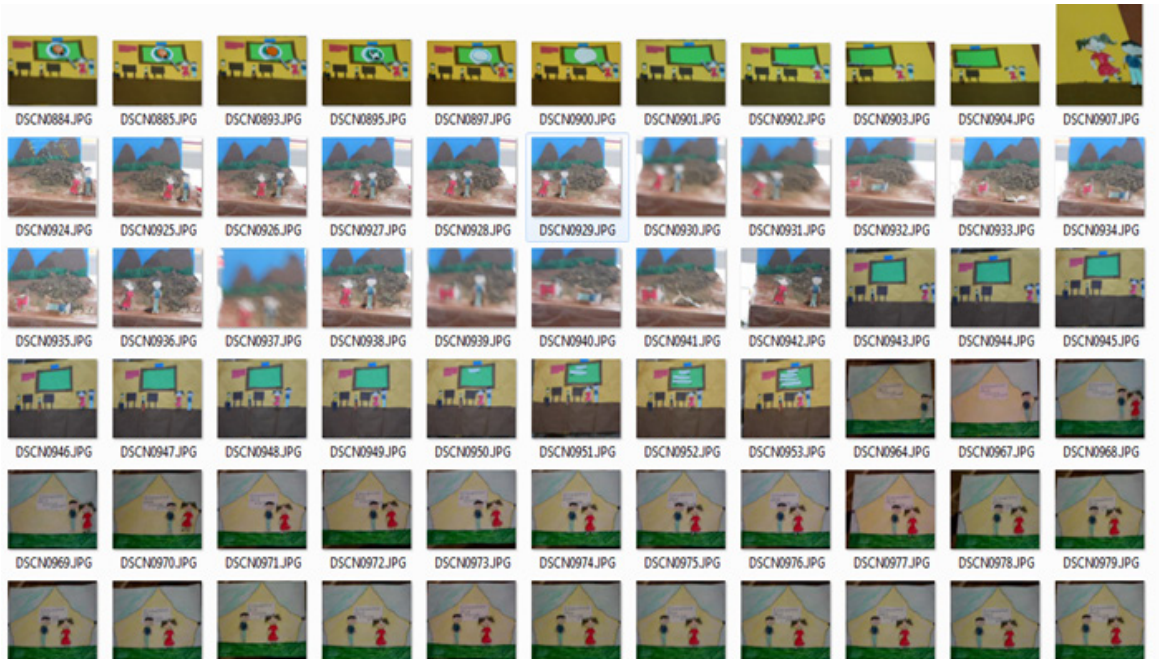
It was determined that students utilized and developed "creativity and innovation skills" in the production stage and sub-skills of "producing solutions, using new technologies, imagination and creating products" were identified. To prevent students to limit themselves, sufficient amounts of material (construction paper, crayons, marker pens, playdough, glue, etc.) and time were made available in this stage. Each student came up with different suggestions about creating the models in this process. The following is a sample of student communications: Berk; Let's draw first, and then cut and paint. Let's do something like this, and then glue something like that on the back, so we could make them move like shadow puppets. Celal; We could do something else as well. We could photocopy Edison; it would be more realistic. And then we could glue it to the stick. But, this one is too small, it needs to be bigger. Yasin; We could put the models on the stool, it would create a background and pictures would have better focus. It was observed that students proposed different solutions to problems they faced. It was also observed that students worked together to resolve the problem and complete the stage without any problems. On another conversation between the students: Beren; We could do it on a A4-size paper, too. As you can see, we experience problems in setting the birds in motion. Eylül; In my opinion, if we do it two-dimensional, using a drawing like this, don't you think we could set it in motion more easily? Beren; We can even do our Carettas like that as well. Let's make them all the same. We can even do the following; we can attach speech bubbles, can't we? Can; It would be super, then we don't even need to talk. It was determined that students utilized imagination skills when producing solutions. It was determined in the beginning of the production stage that students had limited skills in using new technologies but they have developed these skills in the process. Researcher reflected this process in her diary as follows: I provided a camera and a tripod to the students. But I observed that they were not able to use the tripod, holding it in the air and not fixing it on the ground, or did not use it when focusing the photographs. Then, I visited each group to show how to use it. They experienced a few problems even after that but, in a short while all the problems were resolved. It could be stated that each group was able to create the models about "Light and Sound" and "Planet Earth" subjects and animated them and completed the process of taking photographs at the end of the production stage, demonstrating creating product skills. Although several problems were encountered at the beginning of the process in creating products, they have resolved these problems after a while. Students reflected this process in their diaries as follows: Berk; Since we could not write down our story fully, we lost the order of things when taking pictures. We left it the way they were, to be ordered later on. Melek; Since we left our story unfinished, we were not able to finish this as well. Because, we had missing photographs. Researcher wrote the following in her diary about students creating products: Students worked with great will and effort. In fact, they wanted to complete the task of taking photographs without even taking a break. Today, all students completed the task of taking photographs. It was determined that students used "classification-comparison skills" that are considered among critical thinking and problem-solving skills in both units in the production stage. It was also determined that students compared their products in conversations they made within their own groups and with other groups in the production stage. Students reflected the following in their diaries in this process: Aras; The models of other groups are nice, but ours is nice as well when compared to them. Eda; Our models have many superior features. For instance, they are three-dimensional and have several furnishings. Mehmet; Ours look like real, the others not so much. It was determined that students utilized and developed "collaboration and communication skills" in the production stage and sub-skills of "asking questions in the group and the classroom, communicating with friends, resolving conflicts constructively, cooperation support and motivation, sharing and integrating knowledge, listening to ideas and criticizing performances" were identified. Students who experienced problems when photographing the models asked questions to the researcher and to each other. A dialogue between the researcher and students was as follows: Aras; When I take them like this, it comes out too small. Enes; Let me have a look. I think we need to put this a little bit higher. Aras: Also, since the flashlight goes off, it becomes indistinct. Enes; I think we should ask the teacher. Aras; Teacher, we cannot focus this, and the ground is visible, how should we proceed? In this stage, it was observed that group members communicated with each other on issues such as how the models should be or the process of taking photographs. Tolga reflected the communications in the group as follows in his diary: Some of us share their opinion about the objects in the group, altogether Because of this, we created very beautiful models and took their pictures. Students explained in-group communications during the interviews.



Photograph 1. Photo relating to creation process

Reproduction Stage Findings

In the reproduction stage that was the final stage of slow-mation production process, it was determined that students utilized and developed "creativity and innovation skills" and sub-skills of "producing solutions, reading and



Photograph 2. Photo folder of the generated animation

research, using new technologies, imagination and creating products" were identified. It was determined that students had proposals about missing photographs and views on producing animations using different methods. Furthermore, it was observed that each student expressed her or his ideas about the problems they faced. Different solutions developed by the students to improve the animations of other groups after the presentations were as follows: Tolga; They did not provide much information. Also, they could have used the material better. Beren; There could be more photographs and colors. Also, they had less number of photographs. They should have taken more. Irmak; I think it is not good, because they did not share the tasks well. If they had worked together better, it could have been better. Berk; This does not look good, because it's black and white. It could have been more lively if they had used colored pens. Also, the number of photographs are not enough, it could have been more. It was determined that students investigated SMA program and other related programs. Here are some of the conversations between the students on the subject: Aras; Teacher, do you remember what you explained, that thing, movie maker, I asked my father about it. And he showed me. Eda; I checked out the Internet, there was a video showing how it works. But they wrote there that it was a film making program. Aras; It is, but what we do is short animation, isn't it so teacher? Certain students stated that they have investigated movie maker software and found different features about the software. The following is an example of student conversations on the subject: Eda; We have found another place on the timeline after we added the pictures here. Mehmet; Yes, teacher, there is this place where the photographs are, when we move the cursor there, we can extend and shorten the time there. It was determined that students did not research what they should do to color, differentiate and enrich the animations in this stage. Aras wrote the following in his diary about the subject: We added the sound of lightning that we downloaded to the computer at school to the lightning we drew. Our work was different and very nice. Finally, we adjusted the time and our animation was ready. It was identified that students used new technologies related to the subject when transferring the photographs to the computer, editing and combining the photographs and using the animation software.

It was determined that students did not use "critical thinking and problem solving" skills in the reproduction stage. In this stage, it was also determined that students utilized and developed "collaboration and communication skills" and sub-skills of "asking questions in the classroom or in the group, communication with peers, resolving conflicts constructively, cooperation support and motivation, sharing and integrating knowledge" were identified. It was also determined that students posed questions on editing the photographs, making them look better and use of movie maker software to each other and the researcher. The following are examples for these questions: Aras; Teacher, we want to edit these photographs. It happened, the floor is visible. Can we cut this at the sides like we do in Facebook? Aras; In fact, as I did with the one before, I cut it like a slide. It is very easy. Can we do it that way? Irmak; But then we cannot add our voice. We cannot adjust the time. This program is fine. Let's continue. Enes; We learned it anyway. This is easy too. But first, we have to edit the photographs, don't we? It was observed that the students in the first group got along with each other better and spent efforts to complete the stage with success in the first unit towards the final stages of animations. It could be argued that there was an active communication between the students, which did not exist at the beginning of the application process. The following conversation among the students could be considered as an indicator of that fact: Esra; Let's keep each photograph for 0.1 seconds since the number of photographs we have increased. Celal; Exactly, thank you Berk, good of you to say it, otherwise we would be missing many. Esra; Yes, it was, but what we will do now? We have to add these. Melek; Isn't 0.1 seconds too short? Let's make it 1 seconds. Berk; Yes, if we make it 0.1 seconds it will pass through like a jet plane. As could be observed in the conversation among students, students spent effort to come up with a better product and in-group communications improved during the study.

Arithmetic means and standard deviations of pretest and post test scores of each group were calculated to determine the effect of the application on the 21st century learning and innovation skills of the students. t-test was conducted to determine whether the difference between the scores test and control group students obtained in the scale posttest and pretest was significant. Test and control group students' pretest scale score findings are presented in Table 2.

Table 2. *Pre-test score findings for test and control groups on 21st century learning and innovation skills scale*

Student Groups	*N*	*M*	*ss*	*t*	*sd*	*p*
Experiment Group	22	98.81	6.56	0.46	42	> .05
Control Group	22	98.90	6.46			

Table 2 demonstrates that there was a difference of .09 points between the mean scores test group students and control groups obtained in the pretest favoring the control group. t-test was applied to group mean scores to determine whether this difference was significant and it was found that *t*= 0.46. This result demonstrates that the difference between the arithmetic means of two groups was not significant. To determine the effect of the application on 21st century learning and innovation skills the scale was applied to the students in the test group after the slowmation production process once more. Table 3 demonstrates the comparative results of the scores test group students obtained in pretest and posttest applications.

Table 3. *Findings on pre-test post-test scores of test group on 21st century learning and innovation scale*

Student Groups	*N*	*M*	*ss*	*t*	*sd*	*p*
Experiment Group	22	98.81	6.56	4.809	21	< .01
Control Group	22	102.86	5.87			

Table 3 demonstrates that 21st century learning and innovation skill levels of participating students was an average of 98.81 points and the standard deviation was 6.56 points, while their posttest skill levels was an average of 102.86 and the standard deviation was 5.87 points. Analysis of the obtained findings demonstrated that there was an approximate increase of 4.05 points and a decrease of 0.69 points in the standard deviation in the 21st century learning and innovation skills scale applied to a student group of 22 individuals. The fact that an increase was observed in the average scores, while there was a decrease in the standard deviation demonstrated a class-wide improvement in the skill. Although the mean and standard deviation values calculated for pretest and posttest applications show an improvement in 21st century learning and innovation skills, t-test was conducted to determine whether this improvement was significant and overall results are displayed in Table 4.

Table 4. *Sub-skills pre-test and post-test mean scores t-test results*

Skills	*N*	*M*	*ss*	*sd*	*t*	*p*
Creativity and Innovation	22	1.13	1.58	21	3.36	< .01
Critical Thinking and Problem Solving	22	0.22	0.42	21	2.48	> .01
Collaboration and Communication	22	0.27	0.55	21	2.32	> .01

Table 4 is examined, the development of "creativity and innovation" skills .01 level was significant, the development of "critical thinking and problem-solving" and "communication and cooperation" skills were significant at .05 level. Then, in order to determine the effectiveness of the application of the difference between the average of the scores given by the post-test of the students in both groups it was examined whether meaningful or not. The findings concerning the recent test scores taken from the scale of the experimental and control groups are displayed in Table 5.

Table 5 demonstrates that there was a 3.73 points difference between the post test scores of test and control group students favoring the test group. t-test was used to determine whether this difference was significant and *t* value of 2.04 was found. The result demonstrated that the instruction implemented with test and control groups had a significantly different effect on 21st century learning and innovation skills of the students. In other words, it was concluded that slowmation application was effective on the development of students' creativity and innovation, critical thinking and problem solving, collaboration and communication skills.

Table 5. *Findings on pre-test and post-test scores of test and control groups in 21st century learning and innovation skills scale*

Student Groups	*N*	*M*	*ss*	*t*	*sd*	*p*
Experiment Group	22	102.86	5.87	2.04	42	< .05
Control Group	22	99.13	6.20			

Results, Diccussion and Suggestions

In the present study that aimed to determine the effect of slowmation application implemented in primary school 4th grade physical sciences course on achievement of 21st century learning and innovation skills, data on the skills that are determined to be used and improved in every stage of the application such as creativity and innovation, critical thinking and problem solving, collaboration and communication skills and findings and results of related studies are discussed. Qualitative and quantitative data demonstrated that students utilized creativity and innovation skills on every stage of slowmation application and they exhibited improvement in the process. This finding was similar to the results of a study by Koçoğlu and Köymen (2003) where the effect of learning environments that students participated as hypermedia designers on the development of their creative thinking at the end of the process was scrutinized. It was determined that students equally utilized skills of curiosity and reading and research on the subject of the creativity and innovation skills and critical thinking and problem-solving skills in the planning phase. It could be argued that, together with these skills, students within the context of the subject they utilized together or those students who researched the subjects they were curious about utilized and developed critical thinking skills as well. This finding was consistent with the finding by Çalışkan (2009) that research-based learning approach had a positive effect on critical thinking skills of the students. While a finding by Akıllı (2012) that there was a medium level positive and significant correlation between students' critical thinking tendencies and their creative level was similar to the findings obtained during the planning stage, it is not possible to claim this relationship based on the findings of the remaining stages. It was determined that students used new technologies in the planning stage and utilized critical thinking and problem-solving skills in the process. The findings of related studies by Serin, Bulut-Serin and Saygılı (2009) and Saygılı (2010) are consistent with the finding that use of educational technology and material in science and technology instruction had positive impact on students' problem-solving skills. Furthermore, in other stages of the study, it was found that despite the fact that students utilized using new technologies skills, they did not use problem solving skills. Thus, it could be argued that using new technologies in the application stages of slowmation production did not have a positive impact on the problem-solving skills of the students. It was determined that students utilized and developed new technology use skill, which was determined as a sub-skill of creativity and innovation skills in the process. A study by Erol and Taş (2012) revealed that there was a significant relationship between the students' frequency of information and communications technology use and their creativity. Thus, it is possible to argue that students' use of creative and innovation skills and utilization of new technologies are effective. It was determined

that students predominantly utilized critical thinking and problem-solving skills during the planning stage and developed these skills in the process. Furthermore, it was found that students communicated with their peers, asked questions to others and implemented division of labor in the group. This finding is similar to the finding that students collaboratively used and developed problem solving skills during the digital narration process by Hwang and Huang (2012). Thus, it is possible to state that animations that students created in collaboration and communication or digital stories created using similar processes in the learning teaching process develop problem solving skills of the students. The finding by Kurudayıoğlu and Bal (2014) that students' critical thinking skills improved in classes where digital story narrations were used supports the findings of the present study. It could be argued that multimedia tools (slowmation , digital story) created by the students in the process or procured as is contributed to critical thinking skills of the students. It was determined that students predominantly utilized critical thinking and problem solving skills (researching a subject, classification and comparison, giving examples, justification-inference, asking questions, explaining the knowledge using different material, recognizing the connections or contradictions between obtained information, predicting solutions, summarizing the subject) in the planning stage, and utilized classification and comparison skills within the context of critical thinking in the remaining stages. It was concluded that the application provided an opportunity for the students to use their critical thinking and problem-solving skills. This result is similar to the findings in a study by Skinner and Hagood (2008) that digital narrating studies provided an opportunity for the students to express their own experiences and cultural identities and think critically on these. In planning stage, different from other stages, it was found that students utilized and developed critical thinking and problem solving skills and creativity and innovation skills while working in collaboration. This finding is consistent with the result of the study by Yıldız (2012) that collaborative work of students instructed using project-based learning approach increased their creative thinking and problem solving skills. Thus, it could be deducted that problem solving skills of students who work in collaboration are affected positively. The result of a study by Uysal (2009) that instruction conducted with collaborative learning created a significant difference favoring the test group on the development of analysis, assessment, explanation, inference skill, interpretation sub-skills of critical thinking and uniqueness dimension of critical thinking is consistent with the planning stage findings of the present study. It could be argued that groups that worked in collaboration utilized collaboration and communication skills in other stages of the study, while utilizing critical thinking skills only partially or did not used these skills at all.

It was found that students utilized producing solutions, reading and research, imagination, following scientific publications, using new technologies sub-skills of creativity and innovation skills in the narrating stage and developed these skills in the process. In a study by Ersoy and Başer (2012), it is consistent with the finding that scenario-based instruction on producing though and multidimensional thinking skills of creative thinking skills of students. It was determined that communication and collaboration skills that students partially used in planning and narration stages demonstrated a development in the proceeding stages. This finding is similar to the finding by Ming et al. (2014) in their study that showed use of digital narration, which is similar to slowmation, developed communication skills of students. It was determined that students predominantly used collaboration and communication skills in the stages of designing and photographing the models and their transformation into an animation. It was determined that, although the communication was fine between the students, division of labor was not implemented in reproduction stage. It was determined that students utilized collaboration and communication skills in production and reproduction stages and produced products in the process. It was concluded that, in the project-based slowmation application where a product was created, students utilized and developed communication skills in the process and problems were experienced in division of labor in the later stages of the application occasionally. These results are consistent with the findings by Dağ and Durdu (2011) that the instruction process where project-based learning approach was used also affected the development of students' group work and collaboration skills and there were problems in sharing and implementation of tasks and duties, although in-group communications were fine in group studies. It was determined that students utilized use of new technologies skills in every stage of the application and developed these skills in the process, the application rendered the course more entertaining and supported the learning of students. These findings were similar to results of a study by Brown (2011) that slowmation created by students resulted in students learning both the technology and sciences. It was determined that students used their use of new technologies skill during production and reproduction stages, while they created a product. This result was similar to finding by Kidman, Keast and Cooper (2012) that learners' participation in the process and creating a product using their own knowledge and technological skills during slowmation production process would have different effects on learning. In production and reproduction stages of the application dimension of the study and in the planning stage, which is the first stage where the information is structures, it is possible to argue that students created new products using new technologies and expressed their learning in different manners. Furthermore, in a study by Wang and Zhan (2010), the result that courses realized with digital stories developed technology use and problem solving skills of students supports the study results. Results obtained for digital stories created in processes similar to slowmation creation process are consistent with the study results. In the study, it was determined that students utilized collaboration and communication skills and developed these skills in the process. This finding obtained in the study is consistent with the finding that slowmation production process and presentation of the products enabled social interaction among pre-service teachers by Hoban and Nielsen (2012). The result by Brown, Murcia and Hackling (2013) that applications with multidimensional use of technology such as slowmation, students abode study rules in collaboration and developed their work in collaboration. Furthermore, in a research by Sadik (2008), the finding that production process of digital narration, which is a multimedia learning and teaching tool like slowmation, developed communication and collaboration and technology use skills of students is consistent with the study findings. Brown, Murcia and Hackling (2013) demonstrated that intentional learning-teaching condition designed with slowmation provided an entertaining science education for the students, while promoting the development of their scientific literacy. In the study, it is also possible to argue that students learned by entertainment and conducted research together while working in collaboration, and followed scientific publications in the process, and as a result, developed their scientific literacy. It was determined that students utilized sharing and integrating knowledge skill by sharing the information they researched in the group in production and reproduction stages and in the classroom in planning and narration stages, and student statements demonstrated that the application made the course more entertaining. These results of the study are consistent with the finding by Fleer (2013) that preschool students gathered and shared information during slowmation applications and also they were happy and eager for they participated in the process.

It was determined in the study by qualitative data and 21st century learning and innovation skills scale that students 21st century skills of learning and innovation during slowmation production process and demonstrated an improvement in determined skills in all dimensions at the end of the process. This finding is similar with the finding that students used and developed 21st Century skills (critical thinking, problem solving, creative thinking, collaboration and communication skills) in the process of creating educational digital movies by Ochsner (2010). In addition, it is similar to the results of a study conducted in early learning environments by Reid, Reid and Ostachevski (2013) that works created by hand by students based on constructivist theory could be applied to develop 21st Century skills of learners. The results of a study by Hayes (2003) that video production process promoted collaboration among pre-service teachers, developed their critical thinking skills, promoted their creativity and resulted in an entertaining learning experience support the findings of the current study. The findings of the study by Czarnecki (2009) that digital stories produced in a process similar to slowmation production process had positive effect on 21st century skills of students support the findings of the present study. Furthermore, the finding in a study by Talib, Norishah and Zulkafly (2014) that collaborative presentations by students using multimedia tools supported their critical and creative skills is consistent with the findings of the study. Thus, it could be argued that students' presentation of the products they created in the classroom supported their critical thinking and creativity and contributed to development of these skills. In the study, classroom teacher stated that more time was needed for the application to be more successful and effective. The findings in a study by Karakoyun (2014) that digital narration activities created in processes similar to slowmation production process developed 21st century skills of students and sufficient time was needed for the application support the findings of this study. The result by Kotluk and Kocakaya (2015) that students developed learning and innovation skills in the digital narration process since they researched on determined subjects is consistent with the study results. It is possible to argue that students utilized and developed their learning and innovation skills (creativity and innovation, critical thinking and problem solving, collaboration and communication) in the process of production of multimedia learning and teaching tools (digital story, slowmation, etc.).

As a result, SMA production process is an application where students utilize and, in the process, develop creativity and innovation, critical thinking and problem solving, collaboration and communication skills expressed as learning and innovation skills. Students utilized these skills in every stage of the application at a certain extent. It is possible to claim that certain specific skills supported each other in the process. A sample of slowmation production process using basic level technologies was reflected in the study. It is possible for students to adapt the animations they created in the class to different courses or to use this application in their social lives.

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National and Cultural Values According to The Perceptions of Third Grade Primary Students*

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Abstract

One of the lessons that contribute to the education of individuals who have national and cultural values as well as universal values such as tolerant, virtuous, healthy, honesty, responsibility, scientific, love and respect is Life Studies course on primary schools. Life Studies course is one of the courses taught by students in primary schools and the main objective is to provide students with knowledge, skills and value. One of the highlighted values and skills in the 2018 Life Studies Course Curriculum is Recognition of National and Cultural Values (Ministry of National Education, 2018). The aim of this study is to reveal the perceptions of third grade students about their national and cultural values. In this study, the perceptions of third grade students about national and cultural values are examined based on their opinions and drawings. The method was art-based research. 40 students (22 female and 18 male) participated in this study, which aimed to reveal the perceptions of third-grade elementary school students on national and cultural values. In order to determine the participants, criterion sampling was used. In this research, which aims to reveal the perceptions of third-year elementary school students on national and cultural values, the findings were presented as two main themes: "Reflection of National and Cultural Values in drawings and written opinion" and "Characteristics of National and Cultural Values" and sub-themes under each theme. While some of the students draw an object or figure as a national and cultural value, some students drew more than one figure or object related to different national and cultural values in the drawings. Some students emphasized different national and cultural value in their written opinions and paintings.

Keywords: Primary School, Art-Based Research, Drawing, National and Cultural Values, Turkey

Introduction

While developments in science and technology provide the necessary opportunities for individuals to improve their lives, on the other hand it also confronted with problems such as environmental pollution, global warming, violence and terror. Individuals must have some properties to overcome with these problems and to be able to live in tolerance and respect with other individuals in the complex society. These properties appear as values. The value can be determined as "the whole of the material and spiritual elements that cover the social, cultural, economic and scientific values of a nation" (TDK, 2012) and "the whole of the beliefs that contain the most basic characteristics that differentiate human from other living things" (Ulusoy & Dilmaç, 2012, p. 16).

Culture is a collection of formal and peculiar values of all societies and communities that exist in the world (Paşaoğlu, 2009, p.144). Values determine the common behavior patterns that must be followed in the society by creating social solidarity (Yaman, Taflan & Çolak, 2009, p.107). In this respect, cultural values affect the culture and culture affecT cultural values. The change or differentiation in the common behavior of the society is reflected in the culture of the society and the cultural values of the society (Kasa, 2015). With regard to the third learning domain "Culture and the arts" there is an expectation that children and young people will have opportunities for creative expression in a wide variety of art forms and cultural experiences to foster knowledge and skills in the area of the creative arts and culture, personal and communal identity, and awareness of and respect for diversity.

Values education is an important process that ensures the continuity of societies by enabling individuals' internaliZation of values. By means of values education, individuals are able to transfer their culture to future generations (Bayır-Gürdoğan, 2019, p.403). Values bring a sense of security, meaningfulness, purpose and a sense of future into the individual's participation in social life. Values are used to describe societies and individuals, to monitor the change over time, and to explain the motivational basis of attitudes and behaviors. When values are used for qualification and discovery among cultures, they represent shared abstract ideas about what is good, what is right or what is desirable. Cultural values serve as the criterion used to explain which behavior individuals have in society, to guide their self-presentation and to defend their own preferences. Some of the social, historical and intellectual values becomes the society's cultural values. Each culture has its own human, society and world understanding and values.

Values education starts informally in the family and continues in formal schools. The values education is carried out through education programs in schools as well as through implicit programs. Nowadays, rapid technological and scientific developments deeply affect societies and especially human relations; The importance given to the acquisition of values through a curriculum to the new generation is increasing. One of the lessons that contribute to the education of individuals who have national and cultural values as well as universal values such as tolerant, virtuous, healthy, honesty, responsibility, scientific, love and respect is Life Studies Course on primary schools. Life Studies course is one of the courses taught by students in primary schools and the main objective is to provide students with knowledge, skills and value. One of the highlighted values and skills in the 2018 Life Studies Course Curriculum is Recognition of National and Cultural Values (Ministry of National Education, 2018. This study is limited with these values.

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The aim of this study is to reveal the perceptions of third grade students about their national and cultural values. Art-based research was used as the method in the research and the drawings of the students were used. The drawings that are drawn by children provide researchers with a different sequence of data and an alternative means of perceiving it (Kendrick & Mckay, 2004, p.110). Thus, it is considered that it is important to reveal the perceptions of students about national and cultural values through art-based research.

Method

The art-based research content artistic process, forms and applications in scientific field. Art-based research has therefore benefited from creative arts to shape and inform social science research (Sinner, Leggo, Irwin, Gouzouasis & Grauer, 2006, p. 1226). Art-based research describes an epistemological foundation for human inquiry that utilizes artful ways of understanding and representing the worlds in which research is constructed (Finley, 2008, p.79). The aim in art-based research is to understand and explain the experiences of the researcher and the participants in the research process of the artistic process and the artistic forms (McNiff , 2007, p.40; Mullen, 2003, p.166). It can be suggested that art-based educational research approach possess some applications which help research process sustain more effectively and authentically. The investigation of the process by its nature in a constructive and multidimensional way offers researchers unusual departure points. This case may make the research an authentic, creative and qualified one (Duygu & Erişti, 2015, p.395). Art-based methodological outcomes are validated not primarily through a triangulation of methods but within what I would describe as ephemeral constructs of validity. Art praxis methodology invites an anti-foundational "validity of transgression that runs counter to the standard foundational validity of correspondence". It has been striking to note how flexible the concept of validity is, and that it is not an unusual practice to determine alternatives to conventional conceptions of validity when altering research paradigms and/or designs (Eisenhart & Howe, 1992; Lather, 1993, p.675; Cited: Rolling, 2010, p.109). In art-based research, participants present their perceptions of facts or situations in an artistic way (Eisner, 2006, p.11). One of these ways is children's drawing. Children's drawings reflect the thought and emotion in the child's mind, and the symbols and figures used by the child give a hint about the subject (Greig, Taylor & Mackay, 2007, p.93). Children's drawings have helped them communicate the diverse ways in which they see themselves and others as literate beings across contexts such as home, school, and community (Pirtle & Maker, 2012, p.146). In this study, the perceptions of third grade students about national and cultural values are examined based on their opinions and drawings.

Participants

40 students (22 female and 18 male) participated in this study, which aimed to reveal the perceptions of third-year elementary school students on national and cultural values. 36 students aged 9 and 4 students aged 8 participated in this study. In order to determine the participants, criterion sampling was used. The basic understanding of criterion sampling is the study of situations that meet a predetermined set of criteria (Yıldırım & Şimşek, 2011, p. 112). In this study , it was taken as the criteria that students should be studying third grade in primary schools in different socio-economic levels. The reason for the selection of the third grade students in the study; students have the Life Studies course. "Recognition of National and Cultural Values" is including as a life skill in the Life Science Course Curriculum.

Data Collection

The data of the research conducted in order to reveal the perceptions of the national and cultural values of the third grade elementary school students were gathered in March 2018. In the process of data collection, firstly, these questions were asked to students: "What do you understand when it is said that national and cultural values? What are you thinking about?" and than wanted to draw about national and cultural values. In art-based studies, children are asked to draw a case or situation in a verbal or written way (Mair & Kierans, 2007). In this research it was asked to the participants "Can you tell us the drawing you made? What did you draw? and What are your thoughts on national and cultural values?".

Data Analysis

Descriptive analysis technique was used to analyze the data obtained from the study. In the descriptive analysis, themes are determined first, the data are summarized and interpreted within the scope of these themes and direct quotations from the interviews or observations are included. The reason for direct quotations is to reflect the views of the interviewed or observed people in a striking manner (Yıldırım & Şimşek, 2011). In this way, firstly the drawings that the students have drawn are examined and a checklist has been created to determine what is in the drawings. Checklist is as follows:

Table 1. *Checklist For Researcher*

Criterions	Picture/Student's Interviews/Number of Research/	Researcher
Which units are included in the picture drawn by the students?		
What are the units of the students' interviews?		
Is the discourse of the students interviewed with the units in the picture consistent with each other?		
Are the themes and the themes created by the researchers consistent with each other?		

According to the checklist above, the researchers completed the students' drawings and the students' interviews. Then, a form was formed for the students' written expressions, and descriptive index and research interpretation sections were opened to the forms. Forms and checklists were separately filled by each researcher. Below is a sample checklist.

As shown in Table 2, each researcher separately analyzed the data according to the questions on the checklist and completed checklists for each student and each image for data analysis. For the first question in the checklist, each researcher examined the picture drawn by the student and wrote the elements in the picture to the checklist. For the second question, each researcher filled the checklist taking into account the views of the students. For the third question in the checklist, each researcher examined the consistency of the student's drawing with the picture drawn by the student and decided whether it was consistent. As a final question, each researcher decided what theme would be by taking into consideration the elements of the student's drawing and the student's view. Thus, each researcher completed both the data analysis and the preliminary study for validity and reliability by filling the checklist.

Table 2. *Sample Checklist*

Criterions	Number of picture	Picture/Student's Interviews/Number of Research/	Researcher
Which units are included in the picture drawn by the students?	39		Coffee cup, coffee plate, sugar, a small glass of water (items next to Turkish coffee)
What are the units of the students' interviews?	39	S39 "I drew our local drink, coffee. "	The student stated that he drew Turkish coffee.
Is the discourse of the students interviewed with the units in the picture consistent with each other?	39		Yes, it is.
Are the themes and the themes created by the researchers consistent with each other?	39		Customs of /Themes

Validity and Reliability

In this study, some measures have been taken by the researchers to ensure the validity and reliability. These measures are shown in table 3 below.

Checklists and forms were filled separately by researchers to ensure the reliability and validity of the research. And then the researchers compared the checklists and forms together. In cases where there is a conflict in the checklists and forms, the drawings and written expressions of the students are reviewed again and again. After that, these checklists and forms were presented to two experts (from faculty members specialized in visual arts teaching and values). Two experts and researchers came together to discuss checklists and forms, and experts and researchers have disputed the control list and two units on the form. Relevant drawings and student castings were reviewed and the dispute was resolved, a consensus was reached. The findings were presented without comment and direct quotations were made in the presentation of the findings and the images were used. In addition, student names were coded like S1, S2, S3. Students used more than one national and cultural elements in their drawings. Therefore, symbols and figures in a drawing can be placed under multiple themes.

Table 3. *Roads Used to Provide Validity and Reliability in Research*

Validity	Internal Validity	Obtaining expert opinion
		Direct quote
		Support with images
	External Validity	Explanation of data collection tool and process
		Explanation of data analysis process
		Describing the implementation process of the participants
		Purpose sampling (Being a student of third grade in primary school and attending the Life Studies Course)
Reliability	Internal Reliability	Presenting the findings without comment
	External Reliability	Checking the consistency between data
		Checklist

Findings

In this research, which aims to reveal the perceptions of third-year elementary school students on national and cultural values, the findings were presented as two main themes: "Reflection of National and Cultural Values in drawings and written opinion" and "Characteristics of National and Cultural Values" and sub-themes under each theme. The themes obtained are shown in figure 1.

Symbols, images, figures, objects related to national and cultural values in the students' drawings were in the theme of "The Reflections of National and Cultural Values in Drawings and Written Opinion, and the sub-themes were "Customs, Arts, Language and Sports, Fatherland, History and Religion". The theme "Characteristics of national and cultural values, is divided into "Inheritance, belonging, promotion and lifestyle" categories. Figure 2 shows the elements that the students draw on the custom sub-theme.

In the drawings of students within the scope of national and cultural values, they focused on food culture, clothing, dowry and wedding. Students drew "ayran, Turkish coffee, tea" as a drink, and "Turkish pizza, baklava, künefe, tulumba, pita, rice" as a food for the sub-theme of Food Culture. Student 15 "I draw the coffee because its our regional drink.". Students' drawings are as follows.

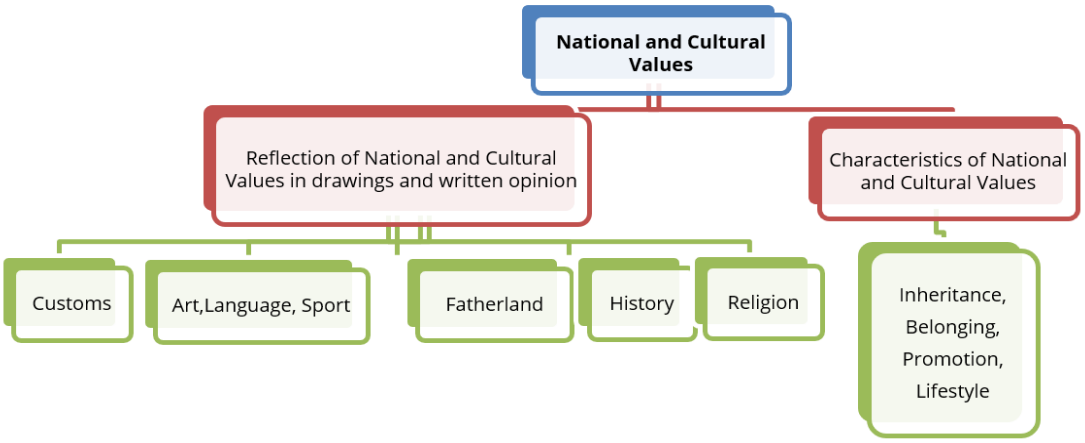


Figure 1. National and cultural values of primary school third-grade students

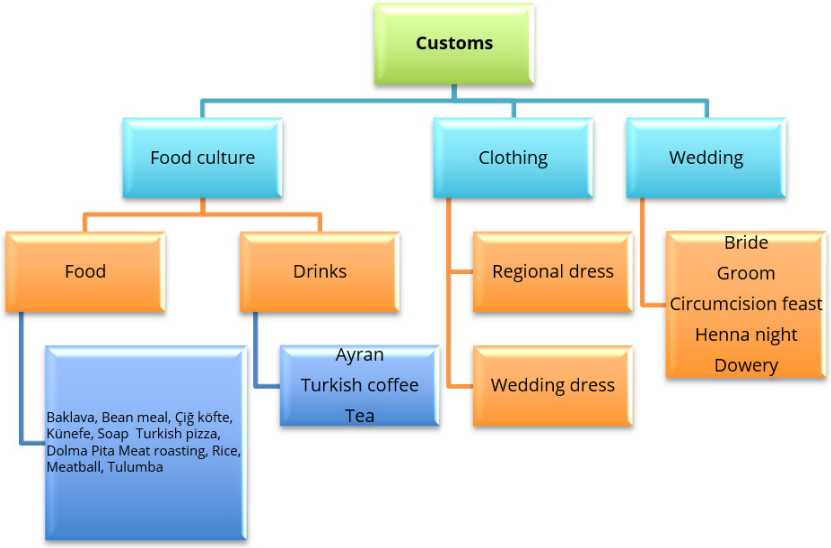


Figure 2. Customs in the drawings of third-grade students

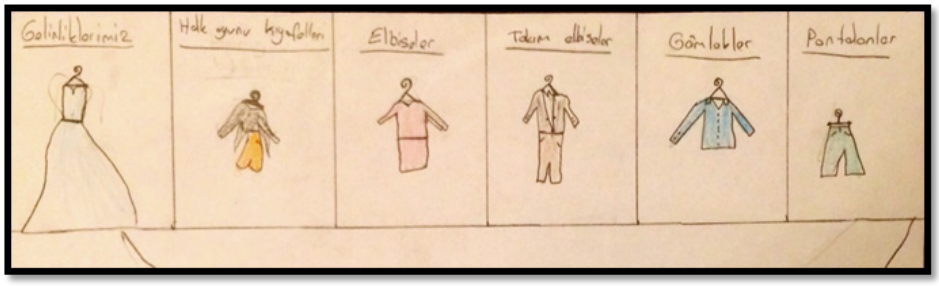
Drawing 1. Student 1

Drawing 2. Student 7

Drawing 3. Student 28

Drawing 2. Student 16

Drawing 5. Student 20



Drawing 6. Student 13

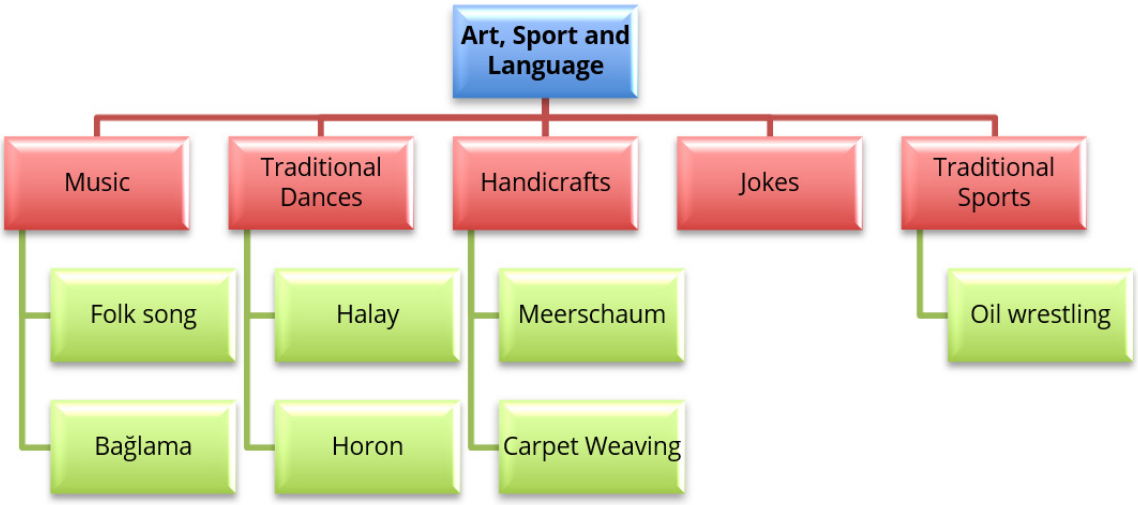


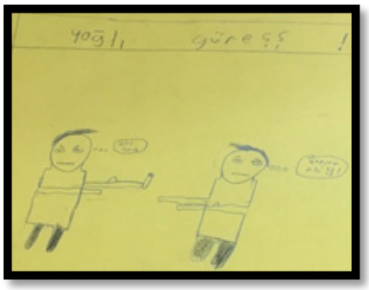
Figure 3. Art, sports and language in the drawings of third grade students

It was seen that students drew regional clothes and wedding dresses as a national and cultural values. In addition, students have reflected the dowry and wedding related items in their drawing as customs. The drawings of students are as follows.

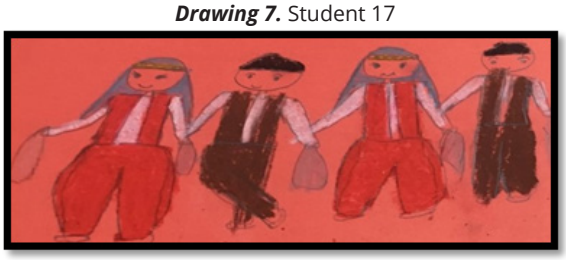
S28 said that "I drew wedding, bride and groom. They came to my mind when I thought national and cultural values". S13 "I drew wedding dresses and regional dresses. S13' drawing is as follow.

The elements that the students drew as the national and cultural values in the theme of art, sports and language are shown in Figure 3. In the drawings made by students, the elements related to national and cultural values are divided into sub-categories in the form of music, traditional dances, handicrafts, jokes and traditional sports in the theme of art, sports and language.

S19 "I draw Meerschaum and Carpet weaving" as Turkish traditions or values. And S20, "When I said national and cultural values, it comes to my mind our jokes, folk carpet weaving" so they have emphasized our music, handicrafts and language as national and cultural values. Again from S31 I draw halay as a national and cultural value because each region has its own dance. For example, they play horon." The drawings of the students are as follows.



Drawing 7. Student 17



Drawing 8. Student 31

The elements that the students draw in the theme of religion as national and cultural values are divided into sub-categories as religious holidays, Mevlana and place of worship. The items drawn by the students are shown in Figure 4.

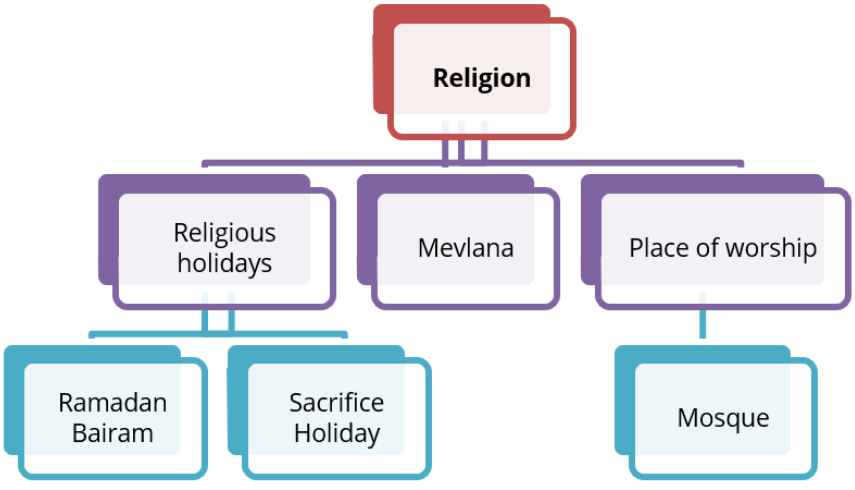


Figure 4. Religion in the drawings of third grade students

Drawing 9. Student 16

Drawing 10. Student 13

Drawing 11. Student 5

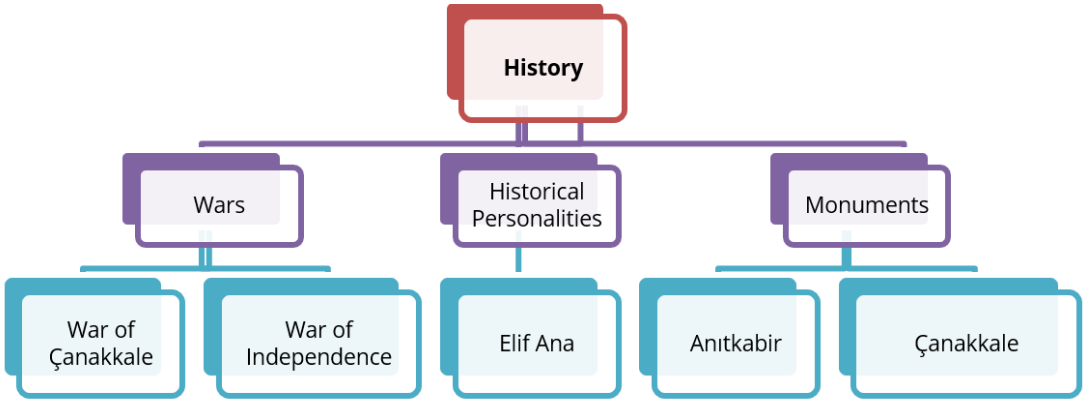


Figure 5. History in the drawings of third grade students

Drawing 12. Student 32 (Elif Ana)

Drawing 13. Student 35 (Anıtkabir)

Drawing 14. Student 3 (Çanakkale)

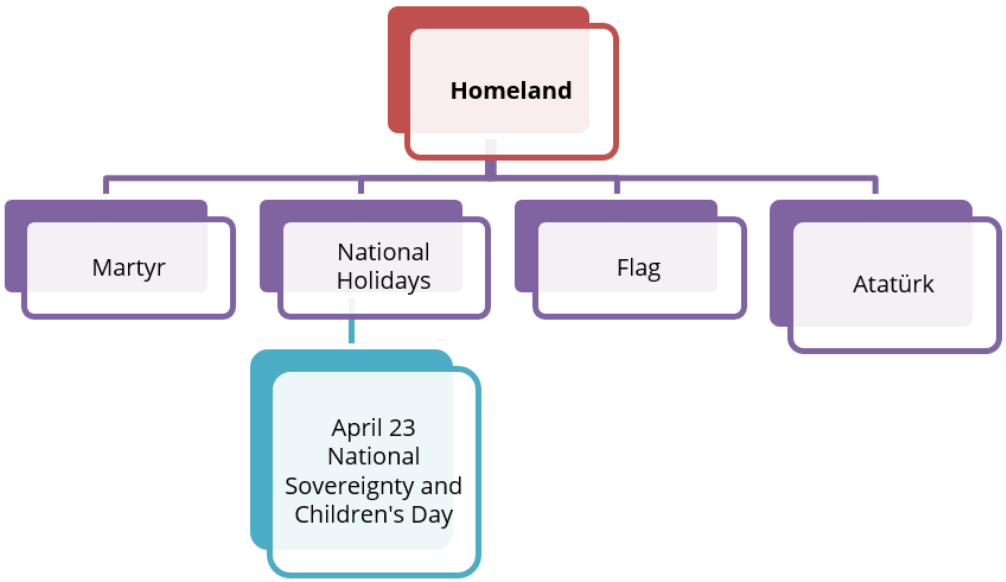


Figure 6. Homeland in the drawings of third grade students

S16 "When it is said national and cultural value, Sacrifice Holiday came to my mind". S8 "I drew a Mosque, because we are a Muslim country." It can be said that students emphasize religious elements as national and cultural values. The drawings of students are as follows:

The history as a national and cultural values; were divided into subcategories as wars, historical personalities and monuments. The items drawn by the students are shown in Figure 5.

S32 "Our heroes came to my mind and drew Elif Ana". S35 "I drew Anıtkabir" and S3 "I drew Çanakkale and the Martyrs Monument there." The drawings of the students are as follows.

S11 "National struggle came to my mind as a national and cultural values. War of Independence is important for us" and S23 "I understand the War of Çanakkale in terms of national and cultural values." It can be said that they have emphasized our recent history as national and cultural values.

Homeland as national and cultural values were divided into as subcategories as martyr, national holidays, flag and Atatürk. The items drawn by the students are shown in figure 6.

S14 "I drew 23 April Feast.", S38 "I drew our flag." The drawings of the students are as follows.

Drawing 15. Student 14

Drawing 16. Student 38

S2 "Atatürk came to my mind. He is important for us" and S35 "Martyrs in the wars came to my mind." It can be said that students emphasize our homeland as national cultural values.

The students stated the characteristics of national and cultural values in a written form. According to the opinions of students, national and cultural values are divided into sub-categories: heritage, belonging, promotion and lifestyle. Figure 7 shows the characteristics of national and cultural values.

S3 "They came us from our ancestors so it is important", S15 "It is important for us because we brought them from past to nowadays." and S22 "National Culture shows us that we are Turkish citizens and they are beauties from of Turkey. If we did not have our national culture, we would not have a culture left to us. According to this views students stated the national and cultural values as a heritage. S34 also stated that "We can show the beauties of our country to other countries and S11 stated that "It is introducing our country."

S31 "Because they show the characteristics of the region such as honey of Erzurum". S40 "Because they are values in our country so they are important" and S21 "Because they are special for us." According to these views they showed that natural and cultural values are special for our country. S8 "We are Muslims so we live like this." and S10 "Because of our values and our national culture are memories from the beauty of Turkey. If we did not have our national culture and value, we would not have any life left to us." According to these views it is emphasized that our national and cultural values are our way of life.

It can be emphasized that the students are aware of national and cultural values as it can be understood from the drawings and written expressions of the third grade students. It can also be said that students care about national and cultural values.

This situation can be explained by students' examples of national and cultural values in their school and daily life. In addition, it can be stated that students are aware of national and cultural values and their families reflect national and cultural values in their homes.

Conclusion, Discussion and Suggestions

The aim of this study, which aims to reveal the perceptions of third-grade elementary school students on national and cultural values, is the perceptions of third-year elementary school students on national and cultural values; were examined by their drawings and written opinions. 22 female and 18 male students participated in the study. The results according to findings obtained in the research are as follows.

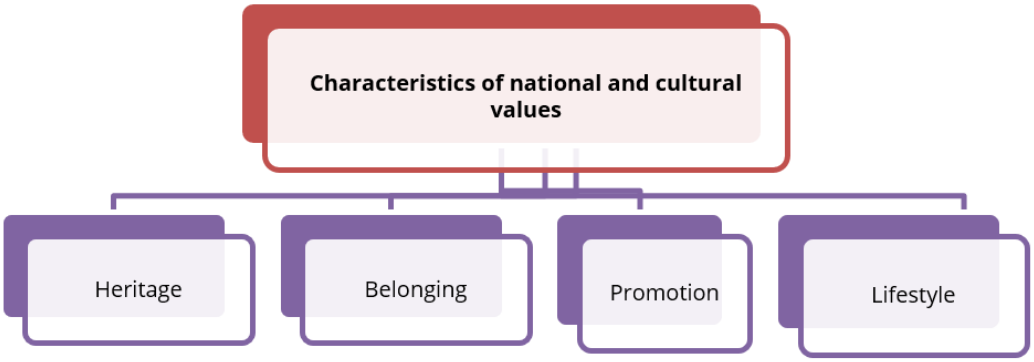


Figure 7. Characteristics of National and Cultural Values

Students drew and expressed their perceptions about national and cultural values with their drawings and written views. While some of the students drew an object or figure as a national and cultural value, some students drew more than one figure or object related to different national and cultural values in the drawings. Some students emphasized a different national and cultural value in their written opinions and paintings. National and cultural values in the drawings and written views of the students were "customs and traditions, art, sports and language, religion, history and homeland". Students who emphasized the traditions and customs as national and cultural values, made drawings of food culture, clothes and wedding related objects or figures in their drawings and written opinions. Some students have meat roasting, rice, Turkish coffee, etc. while some students draw the bride, groom and circumcision feast related to the local clothes and wedding. Some of the students who emphasize art, sports and language as national and cultural values; While drawing meerschaum and carpet weaving, some students drew our traditional sports and dances. In their separate written opinions, they emphasized the joke as national and cultural values. Some of the students who emphasized the religion as national and cultural values on their drawings and their written views were seen to drew objects and figures related to religious holidays and places of worship. Some of them drew Mevlana as a religious character. Students who emphasize history as national and cultural values; In their drawings and their written views, it was revealed that they emphasized wars, historical figures and monuments. It was determined that some of the students who emphasized the homeland as a national and cultural value drew the flag and the objects and figures related to April 23rd National Sovereignty and Children's Day. The students participating in the research showed that national and cultural values inherited from our ancestors, introduced our country, belonged to us, and reflect our lifestyle and emphasized the characteristics of national and cultural values.

In Erişti and Belet's (2010) research, the perceptions of the culture of the fifth grade students of primary schools were examined with their written expressions and paintings. As a result of the analysis of the data, some of the students explained the culture as information about the traditions and traditions of a nation, their backgrounds, and some of them explained the moral characteristics of a community, living and artistic assets, or values that a country possessed. The students expressed that cultural values are very important and should be kept alive. In addition to this, students emphasized especially the marriage ceremony, henna night, meals, dances / games, clothes, sports / horse sports, traditions / customs, soldier farewells, holidays and folk heroes. These results are harmonised to our research.

Özkartal (2009) "The effect of Dede Korkut Epic on the acquisition of national values in the course of primary art activities" aims to draw attention to the existence of Turkish epics from the cultural works and to contribute to the continuation of traditional values. In the experimental study, which was applied with pretest-posttest control group, it was observed that the student achievement and attitudes increased in the experimental group where the national values were emphasized by the drama method. With this research drama was used and we used drawing. These research both show that art could be a way of education in primary schools.

In the study of Kasa (2015) concluded that fourth grade students emphasize cultural values such as weddings, food-beverages and flags within the scope of values. These results are harmonized to our research.

Bozok (2010) "In the eighth grade visual arts lesson, the effect of our national holidays in the acquisition of national values (Sample of 29th October Republic Day and the War of Independence)" is aimed to gain national values by using stories of the Çanakkale War which describes cultural and national values through drama method. In this study, pre-test-posttest control group experimental design is used. As a result of the research, there was a significant difference in favor of the experimental group in the eighth grade visual arts class. It has been observed that student success and attitudes have increased with the method and story used in the experimental group.

Belet and Eristi (2010), aimed to explain the perceptions of the culture (the example of the multicultural Fjell elementary school in Norway). Some students' perceptions of culture in their written narratives have been highlighted by the general conditions of a country, while others reveal the cultural elements of their country such as food, dance, celebration, traditional clothing and holidays. In this study, it is seen that the ethnicity and traditional habits of the majority of the students are important in the formation of the perceptions of the majority of the students.

Schwarts (1999) mentioned values as trans-situational criteria or goals ordered by importance as guiding principles in life. Education is a part of life and has to improve values, with this study it is shown that the perceptions of students about national and cultural values.

One of the aims of education is transforming the culture to new generations. For this aim with this research, it is tried to determine third class primary students' perceptions of national and cultural values. Suggestions according to this research are:

- Quantitative research can be done. It can be studied with different level of class. The sex differences and education level of parents can be examine for national and cultural values.

- It could also study the perceptions of the students about different culture.

- Sample lesson plans can be prepared and implemented and then the effects of these practices can be investigated.

- Studies can be conducted to examine the effects of teacher-parents on students' perceptions of national culture and values.

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Theory of Mind, Emotion Knowledge, and School Engagement in Emerging Adolescents

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Abstract

Theory of Mind (ToM), or the ability to attribute mental states to oneself and others to predict behavior is an important skill that helps adolescents to navigate through school. Building on emerging research on the cognitive and affective aspects of ToM and school engagement, this cross-sectional study explored ToM, emotion knowledge, and school engagement in 32 adolescents (22 females; *M*age = 187.2 mos – 15.16 years, *SD*= 3.29) from central Canada. Positive correlations were found between ToM and school engagement, controlling for language. Higher levels of experiences of guilt and shame were associated with higher levels of ToM and school engagment. Verbal ability significantly contributed to total perceptions of school engagement. Implications for adolescents' social cognition, mental health, and school experiences are discussed.

Keywords: Adolescents; Social Cognition; Empathy; School Engagement; Gender Differences

Introduction

Theory of Mind (ToM), or the ability to attribute mental states to oneself and others to predict behavior is an important social-emotional skill to develop during the transition to secondary school (Hughes, 2011; Lacey et al., 2017). Social-emotional skills such as perspective taking and empathy are especially important for the development of school engagement, memory and academic achievement, and prosocial relations (Ahmed et al., 2018; Estevez et al., 2018; Ross & Tolan, 2017; Zorza et al., 2018). Although past studies have found positive associations among younger children's ToM, memory, and school success (Lecece et al., 2017; Lockl et al., 2017), and social relations (Feldman et al., 2014; Fink et al., 2015; Lecce et al., 2017), few studies explore relations among ToM, empathy, and school engagement in emerging adolescents. That is, to the best of our knowledge, there remains a lack of studies on the connections among ToM and related social-emotional skills, emotion knowledge, and school success in young adolescents (Campbell et al., 2018; Moore-McBride et al., 2016).

The present study takes a new approach and studies the connections between individual differences in ToM, emotion knowledge, and multiple dimensions of perceived school engagement in adolescence. First, it focuses on an understudied and often neglected developmental period in the ToM research area, namely, adolescence. Second, it adopts a multidimensional and psychoeducational focus to ToM and school engagement. Thirdly, given the lack of studies on the role of gender in social cognition and school engagement, we also examined gender-related differences (Devine & Hughes, 2013; Bosacki, 2014).

Social Cognition, Emotion Knowledge, and Relationships during Adolescence

Adolescence is a unique developmental time as this period (approximately ages 12 to 18) represents a transition across many domains such as neurocognitive, emotional, social as well as physical with the hormonal influences of puberty (Blakemore, 2018). Early adolescents' increasingly sophisticated reflection and recursive thoughts about themselves and others play crucial roles in their personal and social lives (Van den Bos et al., 2016). However, following negative academic or social experiences, such as low grades, or conflict with teachers, parents, and peers, these sophisticated social-cognitive abilities may also have a negative impact on students' psychological well-being (Eccles & Roeser, 2011). For example, the psychosocial theory of self-determination claims human well-being and healthy motivation (e.g., intrinsic motivation) are nourished by the fulfillment of three fundamental psychological needs: the need for competence, autonomy, and relatedness (Deci & Ryan, 2014; Dweck, 1999; Pakarinen et al., 2018).

ToM and School Engagement

Researchers have just started to explore the influences of social understanding and social cognitive abilities on school achievement and vice versa (Greene et al., 2018; Wellman, 2016). Past studies with children and adolescents show that students who experience high levels of emotional competence are more likely to develop a positive attitude toward school, to successfully adjust to the world of school, and to improve grades and achievement (Denham, 2006; Tornare, et al., 2015). For example, Trentacosta and Izard et al. (2007) showed that emotion knowledge (the ability to interpret and name facial expressions) at age 5 predicted children's school achievements at age 9. More recently, Denham et al. (2012) found that 3- and 4-year-olds' emotion knowledge predicted teacher-reported school success a few months later.

Other studies have found that emotion understanding predicts young children's school adjustment (Mega et al., 2014), and correlates with performance on a standardized school competence measure (Garner & Waajid, 2008). Regarding cognitive components of ToM such as perspective-taking and understanding false belief, Blair and Razza (2007) found preschoolers' false-belief performance predicted later letter

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knowledge. Given such results, even though belief and emotion understanding can be meaningfully differentiated (Cutting & Dunn, 1999; Fink et al., 2015), they both potentially play a role in young people's school achievement. Such findings also support theoretical work and empirical evidence that suggest that belief and emotion understanding, while clearly distinguishable, are intricately connected indicators of a broader, overarching social understanding or ToM construct (Bialecka-Pikul et al., 2018; Devine & Hughes, 2013; Hughes et al., 2011).

A crucial next step is to learn more about the developmental processes that connect social understanding with school achievement during adolescence. First, evidence is needed to elucidate the associations among adolescents' social cognitive abilities (perspective-taking, empathy), and school engagement during the secondary school years. For example, we need to determine whether more advanced levels of Theory of Mind or social understanding correlate with higher levels of school engagement. Furthermore, to help us understand these connections between social understanding and school outcomes, we need to investigate what kind of explanatory mechanisms that may account for the relations.

Adolescence also represents a unique period for psychosocial and self-development, with an intensified alertness to social comparisons as a mechanism for self-knowledge, particularly about emotions (Blakemore, 2018). However, it remains difficult to disentangle the specific influence of these social cognitive abilities such as ToM and empathy on the development of understanding emotions in adolescence (DeLury et al., 2018; Hughes & Leekam, 2004). Moreover, little is known about how the different dimensions of ToM influence the development of emotion-knowledge such as self-conscious emotions including guilt and shame (Heerey et al., 2003; Spence & Rapee, 2016). Given this lack of knowledge, especially within young adolescents, the goal of this study was therefore to examine the links among early adolescents' social cognitive abilities (ToM – affective and cognitive), emotion knowledge, and their perceived school engagement (cognitive or academic and psychological).

Research also suggests that the connection between social understanding and social competence may provide an important key to understanding children's school achievement (Lecece et al., 2014). A growing body of research shows that social competencies are strong predictors of school readiness and school success (Bakadorova & Raufelder, 2019; Caprara et al., 2000). Children's and adolescents' peer relationships have been found to significantly contribute to school affect, school liking, and school performance (Campbell et al., 2018). Further, rejected children were more likely to show a decrease in academic achievement in the short and long term (Feldman et al., 2014).

The Present Study

The current study has two goals: First, we investigated the existence of relations between ToM and perceptions of school engagement. Second, building on the evidence above that suggests ToM and social competencies predict school achievement, and links between verbal ability, ToM (Flobbe et al., 2008), and school achievement (Leece et al., 2014), we also evaluated whether the above expected associations were independent of verbal ability. Finally, given the mixed past results on the role of gender in these variables (Brandone & Klimek, 2018; Duckworth & Seligman, 2006; Stensen et al., 2018), we also tested for gender differences.

To address these aims, we investigate socio-cognitive predictors of adolescents' school adjustment on one time point, adolescents between 15 and 16 years. In addition, we explored the cognitive and emotional aspects of ToM, as well as the psychological and cognitive domains of school engagement. Consistent with the previous work, we expected to find positive associations among individual differences in adolescents' ToM, empathic skills, and their perceptions of school engagement (in the third year of secondary school) over and above verbal ability.

Method

Participants

As part of a larger 5-year longitudinal study, this study describes the analyses of our Year 3 (2017-8) data obtained from Grade 10 students from 8 schools within Ontario, Canada (N= 32; 22 females; M_{age}= 187.2 months – 15.6 years, SD= 3.29).

Measures

Reading the mind in the eye test – third edition (RMET, Baron-Cohen et al., 2013)

Participants completed this measure as a paper-and-pencil task in a group session which assessed participants' ability to recognize complex mental states. The measure involved 36 items with each item containing a photograph of an expression with just the eyes showing. Four descriptive words, indicating different emotions, were listed and the participant was required to choose the word that best described the expression. Each item had one correct answer and was scored as one point. A higher score indicated a greater ability to read subtle emotions (M= 22.78, SD= 5.40).

Strange stories (White, Happé, Hill, & Frith, 2009)

To assess participants' second order ToM or the ability to recognize and reason about complex mental states, we included a subset of five short stories about mental states were adapted from Happé's (1994) Strange Stories task (themes include a white lie, double bluff, lying, and persuasion). Each story depicted an everyday event in which the main protagonist said something that was not true. Participants were asked a justification question about why the participant made such a statement. Participants' responses were scored using the coding criteria developed by White et al., (2009) with 0 representing non-tangential or I don't know, 1 representing a response that incudes mention of action and is partly correct, and a score of 2 represents a correct response that mentions mental states or a psychological explanation with reference to persuasion, manipulating feelings, or trying to induce guilt/pity. Scores were summed and yielded a total Strange Story score that could range from 0 to 8 (M= 5.89, SD= 2.28).

ToM second order false belief task (adapted from Astington, Pelletier, & Homer, 2002)

This second order false belief task involves a short story that describes a scenario in which three characters are implicated in a social exchange that involves a false belief about a particular event (Astington et al., 2002). The participants are asked about the beliefs and emotions of the characters in the story, and tests the participants' understanding of evidence and truth (M= 3.47, SD= .67).

Empathy (Interpersonal Reactivity Index (IRI, Davis, 1980)

The IRI (Davis, 1980) is the most widely used psychometric test to evaluate both empathy and ToM. The test has

been extensively investigated and validated (Artinger et al., 2014; Davis, 1980). The IRI is a self-report questionnaire that includes abstract descriptions of social interaction which participants respond to. It is a 28-item, 5-point Likert-scale test with four sub-scales: perspective-taking scale (PT), fantasy scale (FS), empathic scale (EC), and personal distress scale (PD).

Test of self-conscious affect (TOSCA-3, Tangney et al., 2000; Tangney, Baumeister, & Boone, 2004)

To assess one's understanding of self-conscious emotions such as shame, guilt, and blaming others, the Test of Self-Conscious Affect (TOSCA-3) was used. This 11 item self-report questionnaire consists of brief scenarios that measure shame, guilt, and blaming others proneness. The scenarios include subjects that are encountered in day-to-day life and to capture the possible reactions in such situations, each scenario is followed by 5 associated responses. The scores range from 1 (not likely) to 5 (most likely) with 3 subscales (shame self-talk, guilt self-talk, and blaming others). The lower the score indicates that you are seldom prone to this behaviour, while a higher score indicates that you often portray this behaviour, (*M*= 3.30, *SD*= .45). Convergent and divergent validity for the TOSCA scales has been well documented and the constructs of shame and guilt demonstrated a unique variance that is functionally distinct (Tangney, et al., 2004).

School engagement instrument (SEI, Appleton, Christenson, Kim, & Reschly, 2006)

This 35-item Likert scale questionnaire assesses the engagement of students at school including cognitive and affective engagement (Appleton et al., 2006). It is comprised of 3 subscales for affective engagement (teacher-student relationships, peer support for learning, and family support for learning), and 3 subscales for cognitive engagement (control and relevance of school work, future goals and aspirations, and intrinsic motivation). There are also additional domains of behavioral engagement and disaffection. The responses range from "strongly disagree" to "strongly" agree" with a scoring range of 35-140. The SEI total mean is the sum of all items divided by 35, psychological engagement (*M*= 3.10, *SD*= .49), and cognitive engagement (*M*= 3.39, *SD*= .34), total engagement (*M*= 3.02, *SD*= .35). Lower scores may be indicative of more absences, disciplinary incidents, or lower achievement performance (Appleton et al., 2006).

Wechsler individual achievement test – third edition (WIAT-III) This measure was used to assess participants' receptive language skills in Year 1 (2015-2016), (*M*= 14.08, *SD*= 1.80) and was administered verbally by the researcher. The measure consisted of 19 items with each item having one correct answer. The participant was shown four pictures on one page and the researcher spoke one word, wherein the participant needed to say (or point to) the corresponding letter (A, B, C, or D) of the picture. Each item had a correct answer and was scored as following: DK for Don't Know= 0, Correct= 1, Incorrect= 0. The maximum receptive vocabulary raw score was 19 and any raw score below 11 was not used. The higher score indicated a more advanced level of listening comprehension and receptive vocabulary skills.

Results

All presented categorical and inferential statitstics were performed using SPSS, version 25.0. Assumptions of normality were examined, as well as Skewness statistics for all study variables. Outliers' values were identified and removed to handle the skewness of the data. Except for Strange Stories variable, no violation of normality was detected.Within the framework of the main hypotheses, results below include descriptive statistics, t-tests (or MANCOVAs – controlling for age and language) for gender effects, and correlations among all main variables. Non-parametric tests were conducted to assess the Strange Stories variable.

Descriptive and Gender Differences

To investigate gender effects across the main variables, we conducted a between-subject MANCOVA using ToM, emotion understanding (IRI, TOSCA), and school engagement scores (SEI) as DVs and gender as IV, including the WIAT or verbal age (VA) and age as the covariates. Results showed that the effect of gender was significant for cognitive ToM (ToM 2nd order), $F(1,22)= 10.87$, $p< .01$, and when controlling for age and verbal age, gender differences were also found in empathy or emotion understanding (IRI), $F(1,22)= 4.75$, $p< .05$.

Table 1 shows the main results for the descriptive data, correlations and gender-differences for the main variables. Results from MANCOVA t-tests showed significant gender differences in emotion understanding (IRI, TOSC). Compared to boys, girls scored higher on empathy (IRI), $t(29)= 2.72$, $p< .01$ (empathetic concern and personal dis-

Table 1. *Descriptive statistics, correlations and gender differences among study variables*

	1	2	3	4	5	6	7	8	9
1. WIAT Recepti Vocabulary	---								
2. IRI Total Score	-0.119	---	.404	0.18	0.29	0.31	-0.107	0.175	0.214
3. RME Total Score	.417*	0.315	---	0.22	0.04	0.14	0.106	-0.107	0.125
4. Cognitive Engagement Score	.502**	0.094	.379*	---	0.28	.696**	0.219	0.118	0.114
5. Psychological Engagement Score	.402*	0.217	0.201	.420*	---	.882**	0.148	0.238	-0.082
6. Student Engagement Total Score	.523**	0.197	0.323	.776**	.899	---	0.249	0.235	-0.005
7. Strange Stories Total Score (Spearmans)	0.412	-0.137	-0.089	0.175	0.437	0.421	---	.473*	-0.087
8. ToM 2nd Order Stories	0.092	-0.343	-0.335	0.260	0.186	0.192	0.437	---	0.109
9. TOSC Total Score	0.162	0.190	0.180	0.179	-0.009	0.080	0.074	0.112	---
MEAN	14.08	3.35	22.78	3.39	3.10	3.25	5.89	3.47	3.30
SD	1.80	0.45	5.40	0.34	0.49	0.35	2.28	0.67	0.45
Diffrence Between Females and Males (T-Test)		2.72**	0.64	0.01	-0.23	-0.15	0.08	0.79	3.02**
MEAN F		3.49	23.18	3.39	3.12	3.25	5.92	3.55	3.46
MEAN M		3.04	21.78	3.39	3.16	3.28	5.83	3.33	2.96

Note: *Correlation is significant at the 0.05 level (2-tailed). **Correlation is significant at the 0.01 level (2-tailed).

tress), and self-conscious emotion understanding with a focus on shame $t(28)= 2.56$, $p< .05$ and guilt $t(28)= 3.54$, $p< .01$. No significant gender differences were found in the ToM measures – either affective (RMET) or cognitive (SS, 2nd ToM 2nd order), or in any of the school engagement measures (SEI).

Relations among ToM, Emotion Knowledge, and School Engagement

Table 1 shows the zero-order and partial correlations (controlling for language) among the main variables. Significant positive relations were found between ToM and perceptions of school engagement. That is, affective ToM (RMET) scores were positively correlated with the perceived cognitive engagement, and with the subscale of psychological engagement (teacher-student relationship) ($r= .396$, $p< .05$). Similarly, cognitive ToM (SS, ToM 2nd order) scores were also positively correlated with the subscale of psychological engagement (family support for learning) ($r_s= .547$, $p< .05$). Controlling for language, affective ToM scores (RMET) were also significantly positively associated with empathy (IRI) ($r_p= .404$, $p< .05$).

Regarding emotion knowledge and ToM, no relations were found between guilt/shame and ToM (cognitive or affective). However, significant positive associations were found for ToM (2nd order) and the empathy subscale (fantasy), ($r= .401$, $p< .05$). Positive links were also found between subscale scores of self-conscious emotions (TOSC) and total empathy scores (IRI) including: empathy and shame, $r= .384$, $p< .05$; empathy and guilt $r= .427$, $p< .05$, and empathy and blaming others, $r= .471$, $p< .01$).

In addition, participants with relatively higher levels of empathy (IRI) and affective ToM (RMET) were more likely to report higher levels of self-conscious emotions (TOSC) such as shame, and to a greater extent, guilt. Significant positive links were also found between total school engagement (SEI) and self-conscious emotions (TOSC) (total school engagement and guilt, $r= .362$, $p< .05$). That is, those students who reported higher school engagement also reported higher levels of guilt.

To test for gender differences between correlations of the main variables, correlations were conducted on two separate samples divided according to gender (girls= 24, boys= 10). For girls only, positive associations were found between affective ToM (RMET) and total student engagement ($r= .493$, $p< .05$), whereas for boys the correlation did not reach significance.

Finally, to test if ToM predicted school engagement, above and beyond the contribution of verbal ability, a hierarchical regression was run with total student engagement as the outcome variable, cognitive ToM (2nd order ToM, SS), and affective ToM (RMET) as predictor variables, and verbal ability (WIAT) as a control variable. Overall the model was significant, $F(3, 25)= 3.23$, $p= .042$, and accounted for 21% of the variance in total student engagement. However, following verbal ability.

Discussion

The present study investigated the connections among Theory of Mind, emotion knowledge, and perceived school engagement in adolescence. Our first aim was to explore the connections among the main variables (controlling for language). Our second aim was to test for gender-differences. Guided by our research aims, results are discussed below within the context of past literature, followed by limitations and implications for education and future research.

Relations among ToM, emotion knowledge, and school engagement

The current study found positive relations among ToM, emotion knowledge, and school engagement. More specifically, we found positive links between affective and cognitive ToM and school engagement. Such findings support past research that shows children with higher ToM, also perform better in school academically (Durlak et al., 2011; Estevez et al., 2018; Mega et al., 2014; Tangney et al., 2004).

However, the present results also showed that those who scored higher on ToM and empathy may also experience greater feelings of guilt and shame (Leece et al., 2017; Lockl et al., 2017). Such findings support studies that suggest being skilled in understanding the perspectives and emotions of others may in part hinder one's private emotion knowledge in that it may reduce one's awareness and attention to the emotional self (Leary & Guadagno, 2011). Cognitive ToM was also found to be positively linked to perceptions of positive family support for learning. More precisely, such positive links between cognitive ToM and students' perceptions of their relationships with their family show that these affective interactions also play a role in students' social and metacognitive abilities (Midgley et al., 1989). Thus, such findings support past research that suggests a bi-directional relation exists between social cognitive abilities and relationship quality in that family and teacher relations may reciprocally influence students' higher-level thinking about emotions and mental states (O'Connor & McCartney, 2007; Pakarinen et al., 2018; Van den Bedem et al., 2018).

The current study's results also suggest that positive links exist among self-conscious emotions such as guilt and shame, ToM, and school engagement. The links between self-conscious emotions and ToM support the theories on emotions that suggest feelings such as guilt and shame are cognitively complex and include self-referential thought (Heerey et al., 2003), as well as an awareness of societal conventions and others' evaluations (Izard, 2007). In particular, a main distinctive feature of self-conscious emotions is that they involve self-evaluation, self-reflection, and self-representation. People are aware of, and reflect upon their actions and evaluate them against socio-cultural and moral norms and standards, and accordingly experience a variety of self-conscious emotions (Heerey et al., 2003; Tracy & Robins, 2007).

This study also found positive links between school engagement and self-conscious emotions (especially guilt) which suggests that students who reported higher psychological engagement in school also reported higher levels of guilt. Such findings support work on the possible negative emotional implications of psychological engagement in learning as students who were psychologically engaged in school work were more likely to feel guilty (or vice versa).

(Tangney et al., 2004). Further, students who are more sensitive to psychological issues within the classroom, may tend to also be more sensitive to criticism and negative evaluations from teachers and/or peers (Leece et al., 2011; 2014).

Precocious self-conscious emotion understanding may also help to promote school engagement and ToM as such students may be more sensitive to others' emotions and be more receptive to learning from others. Such findings have important implications for education and suggest that teachers need to promote emotion sensitivity to others and oneself (Leece et al., 2014). That is, teachers

need to serve as role models and refer to psychological or mental state language within the classroom and in their conversations with students (Venter & Uys, 2019; Vera et al., 2018). In particular, within such conversations, teachers and those who work with youth should aim to avoid negative self-talk around shame and guilt which may lead to harmful psychosocial consequences to students' emotional well-being and their self-worth (Lazuras et al., 2018). Regarding students' perceptions of school engagement, results showed that adolescents' cognitive ToM (SS, ToM 2nd order) was positively related to their perceptions of their psychological engagement in school, especially peer and family support for learning. Such findings suggest that in addition to teachers and families, peers also play an important role in adolescents' learning and school experiences during secondary school. These findings also support past studies that show positive relations with peers may help to influence adolescents' experiences within the school and their overall emotional well-being (Leventen et al., 2018; Madjar et a., 2016; Pratt & George, 2005). Therefore, the combined results of the influence of family and peers' relations on a students' school experiences and their self and social cognition support recent work that suggests high proficiency in ToM may have advantages and disadvantage for young adolescents' psychosocial development, school engagement, and mental well-being (Bosacki, 2016; Hughes, 2011; Leece et al., 2014).

Gender Differences

Our findings suggest that during middle adolescence (15 -16 years), girls and boys are more similar than they are different - especially in terms of perceived school engagement and social cognitive understanding. That is, girls and boys did not differ in terms of ToM or school engagement. In contrast, our results showed that gender may influence individual differences in emotion knowledge. More precisely, we found that girls were more likely than boys to be empathic in an emotional sense, and to engage in more self-talk about negative self-conscious emotions such as shame and guilt.

Such results provide support for past research on the further development of gender differences in the controllability and understanding of one's emotions increasing during school years and into adolescence (Brandone & Klimek, 2018; Duckworth & Seligman, 2006; Stensen et al., 2018). That is, past studies on children's social cognition shows that the students who hold incremental beliefs about emotions (as opposed to entity beliefs) are more likely to score high in self-regulation and well-being. Such findings suggest that gender may influence the links between students' emotion knowledge and relationships within school (Pakarinen et al., 2018; Spilt et al., 2012), mental well-being (Bosacki, 2016; Hughes, 2011; Lecce et al., 2014).

Although some past studies have found gender differences in ToM and school success (Brass et al., 2018; Devine & Hughes, 2013), the present study's null findings regarding gender differences support other studies that show girls and boys may be more similar than different in terms of perceived school engagement (Campbell et al., 2018; Van der Aar et al., 2018). However, compared to boys, we found that girls showed positive relations between affective ToM and student engagement. Such a finding suggests that some girls may be emotionally sensitive to challenges experienced in the school context (e.g. peer or teacher-student conflict, academic challenges). Given that such challenges may lead to negative emotions such as worry, anxiety, and depression, and sensitivity to criticism (Lecce et al., 2011; 2014; Ramirez et al., 2018), future work should explore these variables in connection with self-knowledge and school engagement.

Studies show that educators could help advance adolescents' introspection skills and their ability to consciously monitor of one's own mental and emotional states by providing students with greater access to the challenges in controlling their emotions (Flavell, 2004). Adolescents' enhanced changeability beliefs may also reflect the kinds of emotion coaching and regulatory input they receive from others (Blakemore, 2018). In particular, given the present results and related research that show increasing gender differences in emotion understanding during adolescence (Stensen et al., 2018), males may need to receive more explicit instruction from teachers and parents regarding the need to calm down or stop feeling grumpy that moves beyond asking teens to 'snap out of it.' In contrast, females perhaps need more explicit talk from teachers regarding self-compassion (Gilbert & Procter, 2006). That is, adolescents need parents and teachers to provide them with useful strategies to cope with such negative emotions such as relaxation and mindfulness activities (Eisenberg & Morris, 2002; Rossiter et al., 2018).

For girls only, affective ToM was positively linked to student engagement. Given the lack of research on ToM and students' perceptions of school engagement, such findings support the need for further work. These key findings are discussed each in turn below within the context of previous research followed by limitations and implications for theory and practice.

Positive relations between cognitive ToM and parent-child relationships, and between affective ToM and teacher-student relationships, and perceived support for learning, are consistent with past studies that show ToM skills and emotion understanding may serve as social-cognitive tools to help children and adolescents to develop supportive relationships with others (Lecce et al., 2014; Pianta & Stuhlman, 2004). Such skills may also help them to succeed in communicative and cooperative activities such as negotiation and persuasive skills (Curry & Chesters, 2012; Gruneisen et al., 2015; Peterson et al., 2018).

From a more theoretical point of view, our results support the social-cultural, ecological perspective toward learning (Bronfenbrennet & Morris, 2006). Such a theory claims that students' perspectives of academic school engagement are socially situated within the complex school context, and rely on interpersonal relationships (Bronfenbrenner & Morris, 2006; Hamming & Jozkowski, 2013; Morrow et al., 2014; Vygotsky, 1978). Past studies show that students learn in close collaboration with peers and family (Carpendale & Lewis, 2004; Moll & Tomasello, 2007). Thus, adolescents' academic engagement and success are likely to be strongly influenced by the quality of these social relationships (Pakarinen et al., 2018). For example, past studies report significant relations between emotion regulation and children's academic competence (measured via both teacher's ratings and children's scores on formal tests) in school-aged children (Trentacosta & Izard, 2007). Such findings may be related to broader influences of executive function and self-regulatory skill. Such findings suggest that cognitive ability may represent only one piece of the larger school experience and may be experienced differently across genders.

Accordingly, a key direction for further research is to build on these findings, and to continue to explore how links between student's social cognitive and psychosocial development and school experiences change throughout the school system and across various gender orientations. In particular, researchers need to identify the interaction between social understanding, higher order cognitive functioning, and emotion regulation to predict adolescents' peer relationships, social behaviour, and subsequent

school achievement including self-perceptions, academic school records, and teacher ratings (social, emotional, cognitive).

Limitations and Implications

Our study has a number of limitations that should be acknowledged, and which correspond with directions for further research. First, we used only one task to index language, (receptive vocabulary) and a more comprehensive measure including productive language would provide a more reliable measure. Second, a larger sample size would have provided more power to detect significant relations than in the present study. Third, additional factors such as executive function skills such as working memory and language may also have influenced the present results and future studies should include such variables (Ahmed et al., 2018; Lecce & Bianco, 2018). Lastly, future studies should also explore the same study in different cultures as well as include adolescents from various social demographics.

Limitations notwithstanding, the present study holds important implications for education. As the results suggest, if ToM and related social-cognitive skills such as empathy and social recursive thinking helps adolescents to develop cooperative skills and relationships (Van den Bos et al., 2016), then researchers and educators may wish to focus on interventions in school to enhance adolescents' self-evaluation and ToM skills (Teding van Berkhout & Malouff, 2016). Activities such as role-playing that asks students to take the perspective of others, and to imagine and discuss the emotional experiences of others in a play or story could encourage children to behave in a prosocial manner. In addition, students could read fiction and be encouraged to consider another character's perspective and imagine how the story would end.

Such use of inquiry and dialogue regarding emotions and epistemic cognition or the ways that they acquire, justify, and use knowledge might help them to develop a more open attitude to another's perspective and emotions in socio-cognitive conflicts (Brass et al., 2018; Greene et al., 2018). The present results may promote the development or inclusion of programs that encourage problem-solving, conflict resolution, perspective-taking reflective thinking and metacognitive abilities that may help young adolescents to solve social-cognitive conflict and promote prosocial behaviours in the classroom (Campbell et al., 2018; Yeager, 2017).

Conclusions

The results of the current study suggest that Theory of Mind and school engagement are positively related, controlling for language. Our findings also support the evaluation of separate domains (cognitive and affective) of Theory of Mind and school engagement, especially to identify problematic or protective social cognition and emotional well-being pathways for adolescents' school engagement. Our findings also suggest that gender may influence the relations among emerging adolescents' ToM, emotion knowledge, and school engagement. Theoretically, this study highlights the complex connections between adolescents' ToM, emotion knowledge, and school engagement. Practically, it provides empirical groundwork to support the need for teachers to foster ToM in secondary schools and for educational programs aimed to foster social cognitive and emotional skills and school engagement.

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A Comparison of IRT Model Combinations for Assessing Fit in a Mixed Format Elementary School Science Test

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Abstract

Open ended and multiple choice questions are commonly placed on the same tests; however, there is a discussion on the effects of using different item types on the test and item statistics. This study aims to compare model and item fit statistics in a mixed format test where multiple choice and constructed response items are used together. In this 25-item fourth grade science test administered to 2351 students in 35 schools in Turkey, items are calibrated separately and concurrently utilizing different IRT models. An important aspect of this study is that the effect of the calibration method on model and item fit is investigated on real data. Firstly, while the 1-, 2-, and 3-Parameter Logistic models are utilized to calibrate the binary coded items, the Graded Response Model and the Generalized Partial Credit Model are used to calibrate the open-ended ones. Then, combinations of dichotomous and polytomous models are employed concurrently. The results based on model comparisons revealed that the combination of the 3PL and the Graded Response Model produced the best fit statistics.

Keywords: Item Response Theory, Model Comparison, Mixed Format Tests, Item Fit

Introduction

Tests play crucial roles in individuals' lives. Exams are used for many reasons, such as selection and placement of individuals, determining which knowledge areas need to be improved, and planning and revising educational programs. Test design, analysis of test scores, and interpretation of test results have been important aspects of measuring examinees' trait levels (Kinsey, 2003). Public concern boosts discussions on tests regarding their reliability and validity, which are affected by many elements, such as test length, item format, and scoring.

Multiple choice (MC) items are the most common item types in tests. Despite the fact that the MC format is criticized since examinees can guess the answer correctly, many tests include only MC items due to not only budget and time constraints but also due to the difficulties in defending test scores to the public in plain terms. Although MC items are economically practical and they secure objective and reliable marking, it is difficult to measure higher order thinking with them. In addition, as Lissitz, Hou and Slater (2014) stress, if MC items are exclusively used in testing, the focus of instruction and learning will undermine the analysis, synthesis and evaluation skills of the learners, which in turn risk the loss of the active construction of knowledge. To eliminate these major limitations, it is possible to incorporate constructed response (CR) items in tests. On the other hand, CR items are difficult to score objectively and reliably despite they are considered to be measuring examinees' understanding of the content at a deeper level (Kim, Walker & McHale, 2008). Mixed format tests including both MC and CR items are highly effective measurement tools for teaching and learning to overcome the limitations stemming from their separate use. When they are combined, more reliable content total scores are obtained and a more precise latent trait is defined (Sykes & Yen, 2000). However, as Hollingworth, Beard and Proctor (2007) state, some educators and policy makers believe that constructed response items and multiple choice items do not measure the same construct when placed on the same tests.

The purpose of the present study was to investigate the applicability of separately and concurrently calibrating the dichotomous and polytomous items on a 4th grade science examination data using different Item Response Theory (IRT) models. Therefore, it would be possible to examine how model and item fit statistics vary when MC and CR items are analyzed separately and together. In addition, it will give insight regarding which IRT model is a better candidate for possible further use on achievement test data.

The Classical Test Theory (CTT) has been utilized in many testing systems; yet, it has many shortcomings such as the dependence of the values of item statistics (i.e., difficulty and discrimination) on a particular examinee sample, their average level of ability, and the range of scores. Another important shortcoming is that a valid comparison of examinees coming from different groups is possible only when the same or parallel tests are administered. In CTT, test reliability is described in terms of parallel forms although it is not practical in real world.

IRT has been employed to compute scale scores for achievement tests by most of the testing agencies throughout the world. When there is a reasonable fit between the selected model and data, IRT models produce invariant item statistics and ability estimates. As Hambleton and Swaminathan (1991) explained, the IRT estimate of an examinee's ability does not depend on a particular sample of test items. Also, the precision of ability estimates is known, and free to vary from one examinee to another (Baker, 2001). However, as Bergan (2010) reports, IRT model selection is often based solely on philosophical considerations rather than empirical tests. In general education policies dictate the choice of IRT model which results in a danger of misinterpretation of the data being analyzed as measures of relative fit are ignored (Brown, Templin & Cohen, 2015). Therefore, it is imperative to compare relative fit of competing models to avoid misleading interpretations about the data and making wrong decisions about test takers' performance.

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IRT Models

Many different approaches have been developed to calibrate items in the IRT framework. The current study focuses on item calibrations based on the 1-, 2-, and 3- Parameter Logistic Models (1PL, 2PL, 3PL), the Generalized Partial Credit Model (GPCM), and the Graded Response Model (GRM). The roots of the 1PL model were introduced by a Danish mathematician, Georg Rasch. He demonstrated that item difficulties and examinee ability are sufficient statistics for measurement and introduced the Rasch Model (Rasch, 1960). In the 1PL model which was developed based on the Rasch's work, the probability of getting a correct response is plotted as a function of ability.

$$P_i(\theta_j) = \frac{e^{(1.7(\theta_j - \beta_i))}}{1 + e^{(1.7((\theta_j - \beta_i))}}$$

where θ_j is the ability and β_i is the difficulty parameter. The letter *e* is the base of natural logarithms ($e \approx 2.118$) and the 1.7 in the exponent lets the logistic function approximate the normal function (Warm, 1978). Although Rasch Model and 1PL are philosophically different (Andrich, 2004; Linacre, 2005), the differences between them are not in the scope of the current study. The 1PL model assumes an equal discrimination among all items, and a guessing parameter is not included in the model as it assumes that ability parameter is the sufficient statistic to compare individuals taking a particular test (Baghei and Carstensen, 2013). The two-parameter model was developed by Lord (1952) based on cumulative normal distribution. Birnbaum (1968) replaced the two-parameter logistic function with the two-parameter normal ogive function to model item characteristics (Hambleton, Swaminathan & Rogers, 1991). He modeled the probability of getting a correct response as a function of difficulty and discrimination parameters.

$$P_i(\theta_j) = \frac{e^{\alpha_i(\theta_j - \beta_i)}}{1 + e^{\alpha_i(\theta_j - \beta_i)}}$$

where α_i is the discrimination parameter.

Birnbaum (1968) modified the 2PL model by adding a parameter that represents the contribution of guessing to the probability of correct response (Baker, 2001). That is, the probability of correct response depends on guessing besides difficulty and discrimination in the 3PL model.

$$P_i(\theta_j) = c_i + (1 - c_i)\frac{e^{-\alpha_i(\theta_j - \beta_i)}}{1 + e^{-\alpha_i(\theta_j - \beta_i)}}$$

where c_i is the guessing parameter.

The partial credit model (PCM) was introduced in 1982 by Masters, who decomposed the response to an item into a series of ordered pairs of adjacent categories, then applied a dichotomous model to each pair assuming equal discriminations across the items (De Ayala, 2009). On the other hand, Muraki (1992) extended the equal discrimination assumption and applied the 2PL model to polytomously scored items and introduced the GPCM. This model assumes that the probability of choosing the k^{th} category over the $(k\text{-}l)^{th}$ category is expressed as the logistic dichotomous response model (Muraki, 1992), expressed as,

$$P_{jk|k-1,k}(\theta) = \frac{P_{jk}(\theta)}{P_{j,k-1}(\theta) + P_{jk}(\theta)} = \frac{\exp\left[Da_j\left(\theta - b_{jk}\right)\right]}{1 + \exp\left[Da_j\left(\theta - b_{jk}\right)\right]}$$

where, *k* represents the *n*= 2, 3, ….m, which are the response options. The GPCM is, then, written as

$$P_{jk}(\theta) = \frac{\exp\left[\sum_{v=1}^{k} Z_{jv}(\theta)\right]}{\sum_{c=1}^{m_j} \exp\left[\sum_{v=1}^{c} Z_{jv}(\theta)\right]}$$

and

$$Z_{jk}(\theta) = Da_j(\theta - b_{jk}) = Da_j(\theta - b_j + d_k)$$

where, *D* is a scaling constant (1.7) that sets the θ in the same metric as the normal ogive model, b_{jk} is an item category, and b_j is an item location parameter. While b_j represents the slope, d_k is the category parameter (Muraki, 1993).

GRM was developed by Fumiko Samejima (1969). Within the GRM, the b-parameter for each response category indicates the probability of an examinee whose θ is equal to the value of location parameter *(b)*, scoring *x* or higher is 50% on the CCRF (Tang, 1996). Samejima modeled the probability of a person responding in category *k* or higher versus responding categories lower than *k* as

$$p^*_{ix}\theta = \frac{\exp(Da_i(\theta - b_{xi}))}{1 + \exp(Da_i(\theta - b_{xi}))}$$

where, $P^*_{ix}(\theta)$ is the cumulative category response function (CCRF) representing the probability of scoring *x* or above on item *i* by an examinee with the proficiency level of θ. Probability of each score category is as follows:

$$P_{ix}(\theta) = P^*_{ix}(\theta) - P^*_{ix+1}(\theta)$$

and the score category response function (SCRF) of the GRM can be written as

$$P_{ix}(\theta) = \frac{\exp\left[-Da_i(\theta - b_{ix+1})\right] - \exp\left[-Da_i(\theta - b_{ix})\right]}{\left[1 + \exp\left[-Da_i(\theta - b_{ix+1})\right] - \exp\left[-Da_i(\theta - b_{ix})\right]\right]}$$

The Partial Credit and Generalized Partial Credit Models are generalized from the dichotomous IRT models to describe an examinee's probability of selecting a possible score category among all score categories. Dichotomous IRT models describe how likely individuals at a certain ability level reach the score category *k* rather than *k-1*. So, *k* and *k-1* categories of polytomously scored items can be viewed as dichotomous categories. While the Partial Credit Model assumes that discrimination indices of all items are constant, the Generalized Partial Credit Model releases them free. These differences between the PCM and the GPCM are similar to those between the Rasch or the 1PL and 2PL models (Tang & Eignor, 1997). GRM, on the other hand, assumes that the boundary parameters of the categories are ordered. That is, each score category has a point where the probability of that category is highest.

Method

To realize the aims of the study, different IRT models were applied on the data collected form 2351 fourth grade students in 35 elementary schools in Turkey. The exam was part of a formative assessment initiative. Twenty five science items were asked to all participants, 14 of which were scored dichotomously and the remaining 11 were scored polytomously.

Before the items were written, 10 science teachers were selected as item writers based on school administrators' references and peer ratings about their teaching quality. A two-day training on item-writing was provided to teach-

ers by two educational measurement specialists. Seventy five items were generated by those item writers and 25 items were selected based on content validity indicators set in accordance with the 4th grade science curriculum. The two educational measurement specialists participated in the item selection process along with the item writers. After the selection process, answer keys for each item was prepared by three item writers and the two specialists. During this process, possible and plausible answers for the graded items were prepared and a detailed rubric was developed. After the implementation of the exam, constructed response items were coded 0 if the answer was incorrect. It is coded as 1 if the answer was partially correct, 2 if it was correct, and number 9 was used to symbolize unattempted items.

After data collection, all answer sheets were graded by at least two teachers who also participated in the item writing process. In case there were discrepancies between the ratings of an item, the raters convened, discussed, and decided on the final mark. After the data collection, the dichotomous items were calibrated utilizing the 1PL, 2PL, and 3PL models, and the constructed response items were calibrated through GPCM and GRM. Then, all items were calibrated concurrently using mixed models. After estimating a model, it was compared with a competing more complicated better fitting one. Model selection was based on RMSEA, -2LL, number of unfitting items and item fit statistics as more parsimonious model is preferable. Violating the principle of parsimony creates unnecessarily complicated models and reduces predictions about new data sets (Kang, Cohen & Sung, 2009).

Results

Before performing analysis with IRTPRO (Cai, du Toit & Thissen, 2011), the unidimensionality assumption was tested by performing a categorical confirmatory factor analysis (Cat-CFA) with Mplus (Muthen & Muthen, 2012). A χ^2 value of 1549.42 with a 275 degrees of freedom indicated a poor fit ($p< .01$); however, it is known that Chi-square is affected by the sample size and this result is not surprising. An investigation of TLI (NNFI) (.90) and CFI (.91) results indicated a reasonable fit (Hu & Bentler, 1999). In addition, an obtained RMSEA value of .04 represented a good fit (Steiger, 2007). Therefore, the data set was considered unidimensional.

The first step of the IRT analysis in the current study was calibrating the MC and CR items separately and determining the number of misfitting items. Orlando and Thissen's (2000, 2003) *S-X²* statistics were computed to evaluate item misfits throughout the study. This statistic was originally developed for dichotomous IRT models and was found to perform better than the traditional item-fit statistics. *S-X²* was generalized to the polytomous models by Kang and Chen (2008, 2010). Dichotomously scored 14 items were calibrated with the 1PL, 2PL, and 3PL models. Table 1 below includes the results of the analyses.

Table 1. *Comparison of 1PL, 2PL, and 3PL Models*

	1PL	2PL	3PL
RMSEA	.05	.04	.04
Marginal Reliability	.56	.57	.62
-2LL	33170	33111.03	33037.58
Number of Misfitting Items	2	1	0

As seen above, the 1PL, 2PL, and 3PL models fit the data well based on the RMSEA statistics, each of which has an RMSEA value of .05 or less, indicating a close approximate fit (Kline, 2005). However, the reliability statistics were considered low, which may be due to the small number of items. It is important to note that although marginal reliability in the IRT framework is similar to the reliability in the CTT framework in that it is a measure of the overall test, marginal reliability is based on the average conditional standard errors at various levels on the measurement scale (Geen, Bock, Linn, & Reckase, 1984). Marginal reliability can be expressed as

$$\hat{\rho} = 1 - \frac{\int \sigma_e^2(\hat{\theta}) f(\hat{\theta}) d\hat{\theta}}{\sigma_x^2}$$

in which $\sigma_e^2(\hat{\theta})$ is the conditional error variance and $f(\hat{\theta})$ is the population density (Florida Department of Education, 2015). The literature suggests that the deviance test based on -2log likelihood (-2LL) statistics can be used to assess the model improvement. The difference in the -2LL statistic is distributed as a χ^2 statistic with the degrees of freedom equal to the difference in the number of parameters between the two models. If the difference in the -2LL is greater than the critical value, the addition of the extra parameters contributes significantly to the fit of the model (Hambleton, Swaminathan & Rogers, 1991). The difference in -2LL between 1PL and 2PL ($\chi^2(13)= 58.97$, $p< .05$) was found statistically significant. Similarly, that difference between 2PL and 3PL ($\chi^2(14)= 73.45$, $p< .05$) was also significant. These findings indicate that, as the parameters are added, model fit gets better. Furthermore, while 2 out of 14 items showed misfit in the 1PL model, 1 item showed misfit in the 2PL. All of the items fit the 3 PL model well. Table 2 includes detailed information regarding the *S-X²* item level diagnostic statistics of 14 dichotomous items.

Table 2. *S-X²* Item Level Diagnostic Statistics of MC Items

Item	1PL		2PL		3PL	
	X^2	*df*	X^2	*df*	X^2	*df*
1	12.98	11	11.51	11	13.10	10
2	21.43	9	18.46	9	5.13	9
4	17.87	10	16.26	10	15.92	9
6	28.82*	10	22.13	10	9.37	10
7	19.54	11	15.59	11	15.26	10
8	19.61	11	19.13	11	20.52	10
10	15.46	11	16.01	11	8.39	10
13	21.03	10	21.41	10	21.34	10
16	8.22	9	9.49	8	2.94	7
18	43.64*	11	27.62*	11	13.38	10
19	15.80	10	15.41	10	11.70	9
20	11.66	11	11.29	10	10.62	9
22	19.22	11	19.52	11	17.62	10
24	21.38	11	20.03	11	17.74	10

*$p< .01$

An investigation of item difficulties help one see how those values change as the model improves. As seen above, fit statistics increase significantly as the parameters are added. When Table 3 is examined it is seen that not only item difficulties but also order of the items based on their difficulty values are changed dramatically. For example while item 16 is the most difficult item when 1PL or 2PL is the model of choice, it is the fourth difficult one in 3PL model.

Considering RMSEA values, it might seem logical not to compare models and conclude that 1PL fits the data considerably well, further analysis of -2LL statistics on model improvement it is seen that not only the 3PL model is preferred over the 1PL and 2PL, it can be concluded that the difficulty values obtained for the first two models are misleading. Recall that difficulty parameter represents the

proportion of examinees who respond correctly in 1PL, it represents that proportion after accounting for item-specific discrimination and guessing parameters (Bergan, 2010). After analyzing the MC items, the remaining 11 CR items in the test were analyzed through Muraki's GPCM and Semajima's GRM. As provided in Table 4, the fit statistics based on those two models are similar.

Table 3. Difficulty Parameters and Order of Items Based on Their Difficulties

Item	1PL		2PL		3PL	
	b	*Order of Difficulty*	*b*	*Order of Difficulty*	*b*	*Order of Difficulty*
1	12.98	11	11.51	11	13.10	10
2	21.43	9	18.46	9	5.13	9
4	17.87	10	16.26	10	15.92	9
6	28.82*	10	22.13	10	9.37	10
7	19.54	11	15.59	11	15.26	10
8	19.61	11	19.13	11	20.52	10
10	15.46	11	16.01	11	8.39	10
13	21.03	10	21.41	10	21.34	10
16	8.22	9	9.49	8	2.94	7
18	43.64*	11	27.62*	11	13.38	10
19	15.80	10	15.41	10	11.70	9
20	11.66	11	11.29	10	10.62	9
22	19.22	11	19.52	11	17.62	10
24	21.38	11	20.03	11	17.74	10

*p< .01

Table 4. *Comparison of GRM and GPCM*

	GRM	GPCM	3PL
RMSEA	.04	.05	.04
Marginal Reliability	.78	.77	.62
-2LL	44509.85	44564.98	33037.58
Number of Misfitting Items	3	3	0

Although RMSEA was computed as .05, indicating a good overall model fit, three items had poor fit statistics at .01 level when GPCM was used to conduct the analysis. A reliability value of .77 is considered to be acceptable. When the same 11 CR items were analyzed through Samejima's Graded Response Model (GRM), an RMSEA of .04 and a reliability of .78 indicate a slightly better overall fit than that of the GPCM. Both models had 3 misfitting items. Item statistics are provided in Table 5 below.

As the second step of the IRT analyses, all the MC and CR items were calibrated simultaneously and fit indices were examined to compare different models. The results of those analyses are given below.

Table 6 shows that the data have acceptable RMSEA and marginal reliability statistics in all combined models. The 1PL, 2PL, and 3PL models combined with GRM and GPCM fit the data well based on the RMSEA statistics. That is, when dichotomous and polytomous items are analyzed together in the current achievement test, both GRM and GPCM can be chosen.

Table 5. *S-X²* Item Level Diagnostic Statistics for Polytomous Items

Item	GRM		GPCM	
	X^2	*df*	X^2	*df*
3	47.11	34	38.76	33
5	60.61*	32	54.41*	31
9	38.43	35	39.80	34
11	34.47	33	42.06	32
12	42.63	32	66.51*	31
14	33.73	32	39.97	32
15	37.00	32	45.54	33
17	55.07*	32	48.00	32
21	46.42	32	44.05	32
23	68.39*	34	87.18*	34
25	41.61	35	43.68	34

*p< .01

A close look at the differences in -2LL statistics revealed that, as more parameters are added to the model, fit gets better. The -2LL difference between the 1PL and the 2PL ($\chi^2(13)$= 545.05, p< .05) was significant; however, the difference between the 2PL and the 3PL was not ($\chi^2(14)$= 13.62, p> .05) if GRM is used for the CR items. Similarly, -2LL statistics difference between the 1PL and the 2PL ($\chi^2(13)$= 287.95, p< .05) was significant; however, between the 2PL and the 3PL ($\chi^2(14)$= 13.42, p> .05), the difference was not significant when GPCM is used for the CR items. These preliminary results suggest that when dichotomous and polytomous models are combined in the same test, GRM and GPCM produce similar results. That is, considering the overall model fit statistics, after one decides which polytomous model will be used; s/he can choose the 2PL or 3PL model for the dichotomously scored items. Yet, one should take the item statistics in consideration before making the final decision regarding the model. Table 7 provides item-level fit values for all combined models.

As Table 7 displays, out of 25 items, 8 items misfit the 1PL, 4 items misfit the 2PL models, and 3 items misfit the 3 PL model when GRM is the model of choice for polytomous items. On the other hand, 8 out of 25 items displayed misfit when the 1PL is applied to the dichotomously scored items when GPCM is the model of choice for the polytomous ones. This number went down to 6 in the 2PL and to 4 in the 3 PL model with the combination of GPCM. When the item diagnostics regarding the MC items are examined, it is seen that items 2 and 7 do not fit under any combined models. Item 6 fits all the models except when the GRM or the GPCM is combined with the 1 PL. Item 13 fits all the models except when the GRM is combined with the 1PL, and the item 18 fits all the models except when the GRM or the GPCM is combined with 3PL. There are three CR items displaying misfit under different models. The fit statistics of the item 12 appear to be acceptable only when the GRM is combined with the 2PL or the 3PL. Item 14 is considered as misfitting like item 18 when the GRM is combined with the 1PL. Item 23 does not fit when the GPCM is combined with the 2PL or the 3PL. Based on the item level statistics, it can be concluded that the data have best fit statistics when the 3PL and GRM models are combined.

Table 6. *Model Fit Statistics of Combined Models*

	1PL & GRM	1PL & GPCM	2PL & GRM	2PL & GPCM	3PL & GRM	3PL & GPCM
RMSEA	.05	.04	.04	.04	.04	.04
Marginal Reliability	.80	.80	.82	.82	.82	.82
-2LL	77330.80	77112.34	76785.75	76824.39	76772.13	76810.97
Number of Misfitting Items	7	8	4	6	3	4

Table 7. *S-X² Item Level Diagnostic Statistics for All Items*

Items	1PL&GRM		2PL&GRM		3PL&GRM		1PL&GPCM		2PL&GPCM		3PL&GPCM	
	X^2	*df*	X^2	*df*	X^2	*df*	X^2	*df*	X^2	*df*	X^2	*df*
1	35.83	26	28.69	25	28.65	24	31.15	26	28.73	25	28.69	24
2	89.85*	24	48.06*	26	48.04*	25	75.22*	26	48.19*	26	48.18*	25
3	68.77	49	68.17	49	67.63	49	53.85	47	53.99	47	53.55	47
4	36.66	26	36.73	26	36.73	25	34.70	25	36.74	26	36.76	25
5	83.45*	49	76.67*	47	75.38*	46	76.33*	48	70.04*	45	69.92	45
6	97.52*	25	42.55	28	33.74	27	68.36*	25	42.39	28	33.86	27
7	76.48*	27	50.72*	28	50.48*	27	60.94*	27	50.94*	28	50.70*	27
8	38.01	26	26.75	25	26.55	24	49.48*	26	26.67	24	26.45	23
9	52.33	47	52.06	47	51.91	47	55.57	48	51.32	47	51.26	47
10	37.28	27	28.39	28	28.40	27	28.53	27	28.44	28	28.51	27
11	73.48	48	46.78	45	46.60	45	59.63	46	53.24	46	53.11	46
12	94.30*	51	66.12	47	66.22	47	95.18*	49	87.58*	45	87.77*	45
13	64.41*	26	30.75	28	30.73	27	45.39	26	30.77	28	30.75	27
14	78.14*	48	42.36	43	42.05	43	69.66	45	53.50	44	53.16	44
15	68.54	49	40.65	44	39.63	43	48.04	46	47.08	45	47.19	45
16	30.63	24	29.25	24	29.28	24	30.24	25	29.54	24	30.27	24
17	68.61	44	64.22	43	63.97	43	61.76	44	64.07	44	63.84	44
18	136.53*	27	51.17*	28	41.38	27	102.20*	27	51.03*	28	41.37	27
19	25.00	27	21.04	27	21.10	26	21.10	27	21.09	27	21.15	26
20	43.58	27	36.47	28	36.43	27	37.43	28	36.56	28	36.51	27
21	64.76	46	58.70	44	59.00	44	62.03	44	61.46	44	61.62	44
22	28.45	26	27.89	26	27.91	25	31.87	27	27.90	26	27.91	25
23	67.58	52	61.73	48	61.61	48	77.30*	47	75.05*	47	74.95*	47
24	26.71	25	25.77	25	25.76	24	25.63	25	25.78	25	25.76	24
25	60.69	50	63.48	52	63.78	52	73.98	49	68.48	52	66.35	51

*p< .01

Since the GRM and the GPCM are not nested models, traditional model comparison statistics, such as comparing -2LL differences, are not appropriate to decide whether a combination of the 3PL and GRM or the 3PL and GPCM models provide better fit for the data used in this study. On the other hand, it is possible to use Akaike's Information Criterion (AIC: Akaike, 1974) and Schwarz's Bayesian Information Criterion (BIC: Schwarz, 1978) for this purpose (Kang, Cohen, & Sung, 2005). As both GRM and GPCM models have the same number of parameters (Bartolucci, Bacci, & Gnaldi, 2015), it is logical to compare them utilizing AIC and BIC. Although significance tests are not available with these statistics, they provide estimates of the relative differences between the two options.

AIC and BIC statistics were computed as 76960.97 and 77393.23 respectively for the combination of the 3PL with the GPCM; on the other hand, an AIC of 76920.13 and a BIC of 77346.63 were obtained when the GRM was selected with the 3PL model for the dichotomous items, which can be considered as a sign that supports the conclusion that the combination of the 3PL and GRM models has a

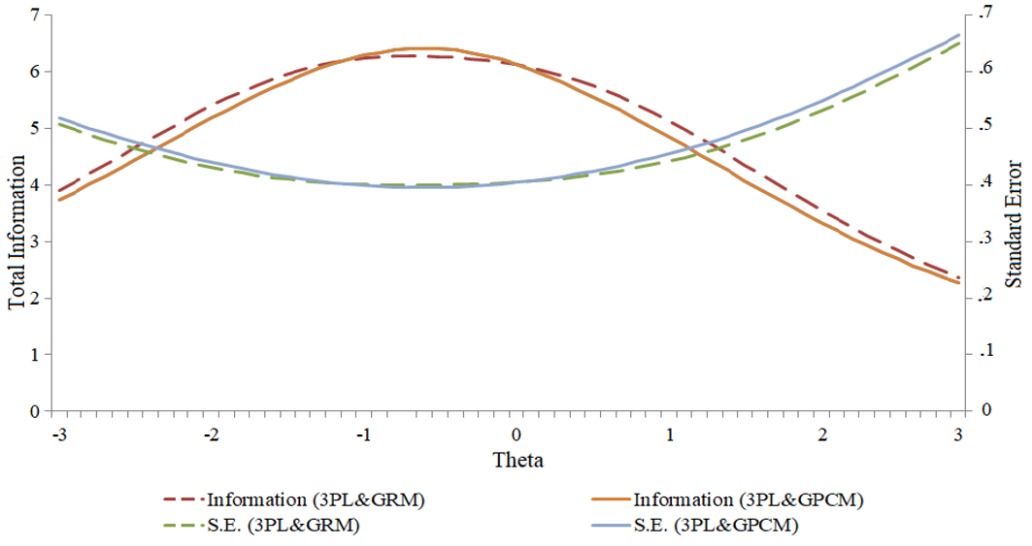

Figure 1. Total Information Functions and Standard Errors Obtained Through Final Models

better model fit than that of the 3PL and the GPCM. A further analysis of total information functions and standard errors would show the difference between the two competing choices.

Above graph compares the test information functions and corresponding standard errors. Combination of 3PL and GRM models provide higher information with lower standard errors as the ability of test takers get closer to the lower end and higher end of the theta distribution. On the other hand, the combination of 3PL and GPCM models provides slightly more information for the students with ability level close to the mean.

General Discussion

The goal of this study was to assess the changes in fit statistics when dichotomous and polytomous items were calibrated separately and concurrently. The 1PL, 2PL, and 3PL IRT models were applied to dichotomously coded MC items, and it was seen that, in general, as the parameters are added to the model, fit statistics get better. When the GPCM and GRM models are compared, the GRM is the model of choice for the analyzed data due to higher reliability and lower RMSEA and -2LL statistics. The results show that multiple choice and constructed response items can effectively be used in the same test when the data are analyzed through IRT models.

It is seen that 1PL&GRM and 1PL&GPCM have the same number of misfitting items; however, 2PL&GPCM has more misfitting items than 2PL&GRM. In addition, 3PL&GPCM has more misfitting items than 3PL&GRM. RMSEA statistics are (.04) the same for all combinations except for the 1PL&GRM (.05). Reliabilities are the same (.82) for all the combined models except for 1PL&GRM and 1PL&GPCM (.80).

Considering the reliability statistics, the change in the number of misfitting items and RMSEA statistics, the most promising combination is 3PL&GRM for the data utilized in this research. The findings support the conclusions reached by Sykes and Yen (2000), who reported substantially more items not fitted when the 1PL is combined with polytomous response models than 3PL. On the other hand, the findings of current study do not fully confirm the findings of Chon, Lee and Ansley (2007), who stated that the 3PLM and GPCM models tended to fit the mixed format data best.

This study serves as a promising step in the utilization of combined models in elementary school tests. More studies are needed to discover the applicability of such analyses in different subjects, such as literacy and mathematics. As indicated previously, the data used in this study are unidimensional. In real situations, it is likely to have a multidimensional data set. Therefore, further studies should be conducted on such data sets. Although misfitting items are determined, the reason for the misfit is out of the scope of the current study. Further studies using effect sizes to quantify the misfits and exploring the reasons for the misfit are encouraged.

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